

# Project Manual

General Documents, Divisions 00, 01 - 49

ISSUED FOR BID

9-25-2020

Project Scope:

**STAFFORD MUNICIPAL SCHOOL**

**DISTRICT**

**LOCKER RENOVATIONS,**

**Stafford, Texas**



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**00 01 10**

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**SUMMARY**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes the following:
  - 1. Project information.
  - 2. Work covered by the Contract Documents.
  - 3. Contractor duties.
  - 4. Work by Owner.
  - 5. Work under separate contracts.
  - 6. Owner-furnished products.
  - 7. Access to site.
  - 8. Protection of work and property.
  - 9. Owner's occupancy requirements.
  - 10. Specification formats and conventions.
  - 11. Provisions for electronic media.
- B. Related Sections include the following:
  - 1. Division 01 Section "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

1.2 PROJECT INFORMATION

- A. Project Identification: Stafford Municipal School District – Locker Rooms Renovations.
  - 1. Project Location: Stafford, Texas
- B. Owner Identification: The City of Rosenberg, Texas.
- C. Architect Identification: The Contract Documents were prepared for the Project by AUTOARCH Architects, LLC, 6200 Savoy, Suite 100, Houston, TX 77036.
  - 1. Contact: Lina Sabouni
    - a. Telephone: (713) 952 – 3366.
    - b. Email: lina@autoarch.net

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:
  - 1. Selective Demolitions within existing locker rooms, and reconstruction of new locker rooms in their place.
  - 2. Demolition of, and reconstruction of existing restrooms and showers at locker rooms.
  - 3. Addition of service sink in Weight Training Room.
- B. The Work Shall conform to and coordinate with Uniform General, Supplemental and Special Conditions.
  - 1. Drawings will be available to Contractor in PDF format for Contractor's use and distribution to subcontractors and suppliers.
- C. Project will be constructed under a single general construction contract

1.4 CONTRACTOR DUTIES

- A. VOC Compliance: Ensure that all assemblies, components, and systems comply with all VOC (Volatile Organic Components) requirements and regulations of the Environmental Protection Agency (EPA) Occupational Safety Health Administration (OSHA), State, County, City, and Local Air Control District.
- B. Except as specifically noted, provide and pay for:
  - 1. Labor, materials, and equipment.
  - 2. Tools, construction equipment and machinery.
  - 3. Water, heat, and utilities required for construction.
  - 4. Other facilities and services necessary for proper execution and completion of work.
- C. Secure and pay for, as necessary for proper execution and completion of Work, and as applicable at time of receipt of bids:
  - 1. Building Permit.
  - 2. Licenses.
  - 3. Bonds
- D. Give required notices.
- E. Comply with all applicable local Building Codes, ordinances, rules, regulations, orders and other legal requirements of public authorities which bear on performance of Work.
- F. Promptly submit written notice to Architect of observed variance of Contract Documents from requirements of authorities having jurisdiction. Assume responsibility for Work performed without such notice known to be contrary to code or regulatory requirements.

#### 1.5 WORK BY OWNER

- A. General: Cooperate fully with Owner so work may be carried out smoothly, without interfering with or delaying work under this Contract or work by Owner. Coordinate the Work of this Contract with work performed by Owner.
- B. Preceding Work: Owner will not perform any construction operations at Project site. Those operations are scheduled to be substantially complete before work under this Contract begins.
  - 1. Data Switches, and Security System Cabling and Security Equipment Installation. [Project Director and/or Architect may attach as appropriate detailed Equipment Responsibility Matrix.]
  - 2. Interior and exterior signage and water leak testing.
- C. Concurrent Work: Owner will perform the following construction operations at Project site. Those operations will be conducted simultaneously with work under this Contract.
  - 1. Telephone Equipment, Audio Visual, Surveying, Geotechnical Study, Materials Testing, Test and Balance of HVAC System. Furniture and OPOI, FFE.
- D. Subsequent Work: Owner will perform the following additional work at site after Substantial Completion. Completion of that work will depend on successful completion of preparatory work under this Contract.
  - 1. Materials testing, install interior and exterior signage and water leak testing.

#### 1.6 WORK UNDER SEPARATE CONTRACTS

- A. General: Cooperate fully with separate contractors so work on those contracts may be carried out smoothly, without interfering with or delaying work under this Contract. Coordinate the Work of this Contract with work performed under separate contracts.

1.7 OWNER-FURNISHED, CONTRACTOR-INSTALLED PRODUCTS (REFER TO ARCHITECT PROGRAM AND DRAWINGS)

- A. Owner's and Contractor's Responsibilities:
1. Contractor shall provide support systems to receive Owner's equipment as well as plumbing, HVAC, and electrical connections.
  2. Owner will arrange for and deliver Shop Drawings, Product Data, and Samples to Contractor.
  3. Owner will arrange and pay for delivery of Owner-furnished items according to Contractor's Construction Schedule.
  4. After delivery, Owner will inspect delivered items for damage. Contractor shall be present for and assist in Owner's inspection.
  5. If Owner-furnished items are damaged, defective, or missing, Owner will arrange for replacement.
  6. Owner will arrange for manufacturer's field services and for delivery of manufacturer's warranties to Contractor.
  7. Owner will furnish Contractor the earliest possible delivery date for Owner-furnished products. Using Owner-furnished earliest possible delivery dates, Contractor shall designate delivery dates of Owner-furnished items in Contractor's Construction Schedule.
  8. Contractor shall review Shop Drawings, Product Data, and Samples and return them to Architect noting discrepancies or anticipated problems in use of product.
  9. Contractor is responsible for receiving, unloading, handling, and storing Owner-furnished items at Project site.
  10. Contractor is responsible for protecting Owner-furnished items from damage during storage and handling, including damage from exposure to the elements.
  11. If Owner-furnished items are damaged as a result of Contractor's operations, Contractor shall repair or replace them with new items.
  12. Contractor shall install and otherwise incorporate Owner-furnished items into the Work, including making building services connections.

1.8 ACCESS TO SITE

- A. Contractor shall have full use of Project site for construction operations during construction period. Contractor's use of Project site is limited only by Owner's right to perform work or to retain other contractors on portions of Project. Make each entity engaged in work on the project aware that the adjacent buildings house operating facilities that must continue in operation during the construction period, except as the Architect and Owner may otherwise direct.
- B. Confine operations at site to areas permitted by Law, Ordinances, Permits, and Contract Documents.
- C. Do not unreasonably encumber site with materials or equipment.
- D. Assume full responsibility for protection and safekeeping of products stored on premises.
- E. Move any stored products which interfere with operations of Owner or other contractors.
- F. Obtain and pay for use of additional storage or work areas needed for operations.
- G. Limit use of site for work and storage as follows:
1. Do not use completed paving areas for storage without Owner's approval.
  2. Do not store materials where trees are located.
  3. Restrict Work and storage to areas indicated on Drawings or approved by Owner.

4. Access site in areas approved by Owner.
  5. Restrict parking to areas approved by Owner.
  6. Do not perform operations that would interrupt or delay Owner's daily operations.
- H. Driveways and Entrances: Keep driveways and entrances serving premises clear and available to Owner, Owner's employees, and emergency vehicles at all times. Do not use these areas for parking or storage of materials.

#### 1.9 PROTECTION OF WORK AND PROPERTY

- A. The Contractor shall maintain adequate protection of the Work from damage and shall protect the Owner's and adjacent property from injury or loss arising from the Work. Contractor shall provide and maintain at all times any OSHA-required danger signs, guards, and obstructions necessary to protect the public and construction personnel from any dangers inherent with or created by the Work in progress.
1. All federal, state, and city rules and requirements pertaining to safety, and all EPA standards, OSHA standards, and NESHAP regulations pertaining to asbestos as required shall be complied with.
- B. Twenty-four (24) Hour Call: The Contractor shall have personnel on call 24 hours per day, for emergencies during the course of the Project. The Owner shall be provided with a 24-hour emergency contact number of Contractor's personnel. Contractor shall be able to respond to any emergency call and have personnel on-site within two (2) hours after contact. Numbers to be made available to the Owner shall include home, office and mobile numbers for the following:
1. Contractor's project manager.
  2. Contractor's field superintendent.
  3. Owner or company officer of Contractor.

#### 1.10 OWNER'S OCCUPANCY REQUIREMENTS

- A. Owner Occupancy of Completed Areas of Construction: Owner reserves the right to occupy and to place and install equipment in completed areas of building, before Substantial Completion, provided such occupancy does not interfere with completion of the Work. Such placement of equipment and partial occupancy shall not constitute acceptance of the total Work.
- B. On occupancy, Owner will assume responsibility for maintenance and custodial service for occupied portions of building.

#### 1.11 SPECIFICATION FORMATS AND CONVENTIONS

- A. General: Specification requirements are to be performed by Contractor unless specifically stated otherwise.
1. The Specifications do not:
    - a. Establish trade jurisdictions or divisions of responsibility.
    - b. Do not define Subcontract scopes of work.
- B. Division 01 General Requirements: Requirements of Sections in Division 01 apply to and govern the Work of all Sections in the Specifications.
- C. Specification Format: The Specifications are organized into Divisions and Sections using the current version of CSI/CSC's "MasterFormat" 50-Division format and numbering system.
1. Section Identification: The Specifications use section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete. Consult the Table of Contents at the

- beginning of the Project Manual to determine numbers and names of sections in the Contract Documents.
2. The order of articles, paragraphs, subparagraphs, and sub-subparagraphs within the text any Specification section is defined by a sequence of indentations.
    - a. Article, paragraph and subparagraph titles, and other identifications of subject matter in the Specifications, are intended as an aid in locating and recognizing various requirements in the beginning words of a sentence.
    - b. Specification text shall govern over titling, and shall be understood to be and interpreted as a whole. Where a title establishes the subject, the titles are subordinate to and do not define, limit, or otherwise restrict the Specification text.
  3. The captions and headings of various subdivisions of the Contract Documents are intended only as a matter of reference and convenience for describing the Work and in no way define, prescribe or limit the scope or intent of the Contract Documents or any subdivision thereof.
- D. Specification Style: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
  2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
    - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.
    - b. Contract Documents may omit modifying words such as "all" or "any", and articles such as "the" or "an". The absence of a modifier or article from one statement that appears in another is not intended to affect the interpretation of either statement.
- E. Specification Content: Drawings and general provisions of the Contract, including the Uniform General Supplemental and Special Conditions and Division 01 specification Sections, apply to the execution of the Work of subsequent specification sections, and vice versa.
1. Work specified in any one Section is related to, and dependent upon, Work specified in other Sections, whether or not specific reference is made to the Work of other Sections. Cross-references in the Specifications are general references intended as a matter of convenience for aiding in the location general information, and are not all-inclusive.
  2. Names, telephone numbers, and web-site addresses and other contact information listed in the Contract Documents are for convenience only, are subject to change, and are believed to be accurate and up-to-date as of the printing of the Contract Documents.
  3. Use of the word "including", when following any general statement, shall not be construed to limit such statement to specific items or matters listed, whether or not non-limiting language (such as "without limitation", "but not limited to", or other words of similar import) is used with reference thereto; but rather, shall be deemed to refer to all other items or matters that could reasonably fall within the broadest possible scope of such general statement.

## 1.12 PROVISIONS FOR ELECTRONIC MEDIA

- A. Project Website:
1. Construction Administration will be utilized through a Web-based Project Management System, Projectmates. This Owner-oriented management information system will provide a project participant the ability to track and manage the entire project. Projectmates will track communication between the Owner, Program Manager, Architect/Engineer, Design Consultants, Contractor and Subcontractors.
  2. The Architect/Engineer shall manage and coordinate the on-going electronic Construction Documents, tracking changes and incorporating same and maintaining current Construction Documents. The Architect/Engineer shall make these available to the Contractor and Owner as required.
  3. Projectmates key features that will be utilized are included but not limited to:
  4. Advanced reporting capabilities for the Owner
  5. Online RFIs and Submittals for the Contractor & Architect
  6. Online Field Reports for field inspectors
  7. Online Change Orders & contracts for the contract Manager
  8. Project Detail tracking:
  9. Notes
  10. Tasks
  11. Schedule
  12. Meetings
  13. Permits
  14. Storm water (SWPPP)
  15. Architect Field Observations
  16. Payment applications
  17. Constructability
  18. Online Project Directory
  19. Email-based alerts
  20. Task Management
  21. Site Photographs / Image Gallery
  22. Multi-tiered User Access
  23. Role-based security & permissions
  24. Advanced error tracking
  25. Final Project Archive
- B. Electronic Drawing Documents:
1. Electronic file copies of the Contract Drawings in latest AutoCAD in electronic format approved by LSC format may be obtained from the Architect. Contact Architect to determine availability of CAD documents and costs.
  2. Liability release and transfer agreement shall be executed and submitted by Contractor prior to turn-over of electronic files. Refer to Agreement Form included at end of Section 01 33 00.

**PART 2 PRODUCTS** - Not applicable to this Section

**PART 3 EXECUTION** - Not applicable to this Section

END OF SECTION

**01 22 00**

**UNIT PRICES**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for unit prices.
- B. Related Sections:
  - 1. Division 00 Competitive Sealed Proposal Form – Alternates and Unit Pricing.
  - 2. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.
  - 3. Division 01 Section "Quality Requirements" for general testing and inspecting requirements.

1.3 DEFINITIONS

- A. Unit price is an amount incorporated in the Agreement, applicable during the duration of the Work as a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are either increased or decreased.

1.4 PROCEDURES

- A. A Unit Price is a cost for a unit of work, as described in the Proposal Documents. The Owner may add or deduct Unit Price work at the amounts stated on the Proposal Form and such amounts shall not be subject to additional mark-up by the Contractor or his Subcontractors.
- B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.
- C. If the quantities of the items listed in the Schedule of Unit Prices are increased, the Unit Prices set forth by the Contractor shall apply to such increased quantities. Unit Prices for adjusting the Contract Sum for less work or material installation will be 95% of these amounts.

1.5 UNIT PRICES LIST

- A. Trenching:
  - 1. Trench as required to replace or install new under-slab plumbing. (Price per linear foot) to include:
    - a. Prior to installation of new piping or equipment:
      - 1) Saw-cutting existing slab.
      - 2) Removal of existing slab and dirt to depth required.
    - b. Upon installation and inspection of new piping or equipment:

- c. Replacement of and compaction of select fill (including lime-stabilization and/or cement stabilization as necessary).
  - d. Replacement of concrete slab at trench.
- B. Finishes:
- 1. Replace floor finish in trenched areas (entire room affected by trenching). (Price per square foot).
- C. MEP Work:
- 1. Install underground pipe; including clean outs and joints where necessary (price per linear foot; separate from trenching)

**PART 2 PRODUCTS** (Not Used)

**PART 3 EXECUTION** (Not Used)

END OF SECTION

**01 25 00**

**SUBSTITUTION PROCEDURES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for submitting and processing product substitutions after execution of the Agreement.
- B. For administrative and procedural requirements for product substitutions during the procurement process and prior to execution of the Agreement, refer to the Owner Provided Front End Documents.
- C. Where the Owner Provided Front End Documents and Division 00 provide requirements for substitution that conflict with this section, the more stringent shall govern. The Architect shall interpret the requirements of these sections and shall be the final authority in deciding whether a substitution shall be accepted.
  - 1. Regardless of any conflict, the Substitution Request Form following this section must be completed by the Contractor for all substitution issues.

**1.2 DEFINITIONS**

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
  - 1. Substitution requests will only be considered prior to receipt of Bids except when a specified product or system is no longer available.
  - 2. Owner-requested cost-reduction proposals shall be submitted on Substitution Request Form.

**1.3 DESIGN REQUIREMENTS**

- A. Materials, products, and equipment included in the Contract Documents are specified for the purpose of establishing a minimum standard of quality, cost, appearance, design, and function. It is not the intent to limit the acceptance of materials, products or equipment specified, but rather to name or describe a material, product or piece of equipment as the absolute minimum standard that is desired and acceptable. Where proprietary names are used, whether or not followed by the words "or acceptable substitution," requests for substitution will nevertheless be considered if properly submitted to and received by the Architect prior to the designated date.

**1.4 SUBMITTALS**

- A. Substitution Requests after Award of Contract: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
- B. The Substitution Request Form included as an attachment to this Document shall be used for all Substitution requests. Failure to use the attached Substitution Request form, or failure to fully execute the form as required, will result in rejection of the proposed substitution request without review.
  - 1. Do not make substitution request with shop drawings or product data submittals.

- C. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
1. Statement indicating why specified material or product cannot be provided.
  2. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
  3. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  4. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
  5. Samples, where applicable or requested.
  6. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  7. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  8. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
  9. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
  10. Cost information, including a proposal of change, if any, in the Contract Sum.
  11. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
  12. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.
  13. Only one substitution request will be reviewed for each product or system.

## **PART 2 PRODUCTS**

### **2.1 PRODUCT SUBSTITUTIONS**

- A. Timing: Architect will consider requests for substitution if received within 60 days after award of Contract. Requests received after that time may be considered or rejected at the discretion of Architect.
- B. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner's additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
  2. Requested substitution does not require extensive revisions to the Contract Documents.
  3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
  4. Substitution request is fully documented and properly submitted.
  5. Requested substitution will not adversely affect Contractor's Construction Schedule.
  6. Requested substitution has received necessary approvals of authorities having jurisdiction.

7. Requested substitution is compatible with other portions of the Work.
  8. Requested substitution has been coordinated with other portions of the Work.
  9. Requested substitution provides specified warranty.
- C. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:
1. Evidence that the proposed product does not require extensive revisions to the Contract Documents that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  3. Evidence that proposed product provides specified warranty.
  4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  5. Samples, if requested.

### **PART 3 EXECUTION**

#### **3.1 CONTRACTOR RESPONSIBILITIES**

- A. All requests shall originate from the Contractor. Manufacturers, manufacturer's representatives, dealers, distributors, suppliers, and subcontractors shall not direct or make requests to substitute equipment or materials.
- B. Substitutions shall be submitted to the Architect only; no substitutions shall be submitted directly to any consultant, the Owner, or any of the Owner's consultants.
- C. All requests for substitutions shall be accompanied by manufacturer's product data, specifications, drawings, catalog cuts, samples, installation instructions, performance data, list of projects completed of similar size and scope, and other references and information necessary to completely describe the item, and to facilitate a thorough and complete review by the Architect. Requests not meeting all these requirements may be rejected without evaluation.

#### **3.2 ARCHITECT'S ACTION**

- A. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
- B. Approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered. Approval, therefore, is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed. In proposing items for consideration, Contractor assumes all risk, costs, and responsibility for item's final acceptance, compliance with the Contract Documents, integration into the Work, and performance.

#### **3.3 IMPLEMENTATION**

- A. Form of Acceptance: Change Order.
- B. If Architect cannot make a decision on use of a proposed substitution within time allocated,

or if substitution request is rejected, provide the basis of design product originally specified.

- C. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall remove the substituted product, material, or item and provide the originally-specified product at no additional cost to Owner.

#### 3.4 ATTACHMENTS

- A. Refer to Section 01 25 00x for Post-Award Substitution Request Form.

END OF SECTION

01 25 00x

**SUBSTITUTION REQUEST FORM**

**(After Contract Award)**

**PROJECT:** \_\_\_\_\_

**TO:** \_\_\_\_\_

**FROM:** \_\_\_\_\_

\_\_\_\_\_

**NO.:** \_\_\_\_\_

**DATE:** \_\_\_\_\_

Contractor hereby requests acceptance of the following product or system as a substitution in accordance with provisions of Section 01 25 00 of the Specifications:

**1. SPECIFIED PRODUCT OR SYSTEM**

Substitution request for: \_\_\_\_\_

Specification Section No.: \_\_\_\_\_ Article / Paragraph: \_\_\_\_\_

## 2. REASON FOR SUBSTITUTION REQUEST

### SPECIFIED PRODUCT:

- Is no longer available
- Is unable to meet Project Schedule
- Is unsuitable for the designated application
- Cannot interface with adjacent materials
- Is not compatible with adjacent materials
- Cannot provide the specified warranty
- Cannot be constructed as indicated
- Cannot be obtained due to one or more of the following:
  - Strike
  - Bankruptcy of manufacturer or supplier
  - Lockout
  - Similar occurrence (explain below)
- Will reduce construction time
- Will result in cost savings of \$\_\_\_\_\_ to project
- Is for supplier's convenience
- Is for subcontractor's convenience
- Other: \_\_\_\_\_

## 3. SUPPORTING DATA

- Drawings, specifications, product data, performance data, test data, and any other necessary information to facilitate review of the Substitution Request is attached.
- Sample is attached.
- Sample will be sent if requested.

**4. QUALITY COMPARISON**

Provide all necessary side-by-side comparative data as required to facilitate review of Substitution Request:

	SPECIFIED PRODUCT	PROPOSED PRODUCT
Manufacturer:	_____	_____
Name / Brand:	_____	_____
Catalog No.:	_____	_____
Vendor:	_____	_____
Variations:	_____	_____

(Add Additional Sheets If Necessary)

Local Distributor or Supplier: \_\_\_\_\_

Maintenance Service Available:  Yes  No      Warranty:  Yes  No \_\_\_\_\_ Years

Available Warranty Exceeds that of Specified Product:  Yes  No

Spare Parts Source: \_\_\_\_\_

**5. PREVIOUS INSTALLATIONS**

Identification of at least **four** similar projects on which proposed substitution was used:

**Note: All questions must be answered and all blanks filled in.**

PROJECT #1:

Project: \_\_\_\_\_

Address: \_\_\_\_\_

Architect: \_\_\_\_\_

Owner: \_\_\_\_\_

Contractor: \_\_\_\_\_

Date Installed: \_\_\_\_\_

PROJECT #2:

Project: \_\_\_\_\_

Address: \_\_\_\_\_

Architect: \_\_\_\_\_

Owner: \_\_\_\_\_

Contractor: \_\_\_\_\_

Date Installed: \_\_\_\_\_

PROJECT #3:

Project: \_\_\_\_\_

Address: \_\_\_\_\_

Architect: \_\_\_\_\_

Owner: \_\_\_\_\_

Contractor: \_\_\_\_\_

Date Installed: \_\_\_\_\_

PROJECT #4:

Project: \_\_\_\_\_

Address: \_\_\_\_\_

Architect: \_\_\_\_\_

Owner: \_\_\_\_\_

Contractor: \_\_\_\_\_

Date Installed: \_\_\_\_\_

## 6. EFFECT OF SUBSTITUTION

Proposed substitution affects other work or trades:  No  Yes (if yes, explain)

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Proposed substitution requires dimensional revisions or redesign of architectural, structural, M-E-P, life safety, or other work:  No  Yes (if yes, attach data explaining revisions)

## 7. STATEMENT OF CONFORMANCE OF REQUEST TO CONTRACT REQUIREMENTS

Contractor and Subcontractor have investigated the proposed substitution and hereby represent that:

- A. They have personally investigated the proposed substitution and believe that it is equal to or superior in all respects to specified product, except as stated above;
- B. The proposed substitution is in compliance with applicable codes and ordinances;
- C. The proposed substitution will provide same warranty as specified for specified product;
- D. They will coordinate the incorporation of the proposed substitution into the Work, and will include modifications to the Work as required to fully integrate the substitution;
- E. They have included complete cost data and implications of the substitution (attached);
- F. They will pay any redesign fees incurred by the Architect or any of the Architect's consultants, and any special inspection costs incurred by the Owner, caused by the use of this product;
- G. They waive all future claims for added cost or time to the Contract related to the substitution, or that become known after substitution is accepted.
- H. The Architect's approval, if granted, will be based upon reliance upon data submitted and the opinion, knowledge, information, and belief of the Architect at the time decision is rendered and Addendum is issued; and that Architect's approval therefore is interim in nature and subject to reevaluation and reconsideration as additional data, materials, workmanship, and coordination with other work are observed and reviewed.

Bidding Contractor: \_\_\_\_\_  
(Name of prime bidding contractor)

Date: \_\_\_\_\_ By: \_\_\_\_\_

**Note: Unresponsive or incomplete requests will be rejected and returned without review.**

### 8. ARCHITECT'S REVIEW AND ACTION

- Substitution is accepted.
  - Substitution is accepted, with the following comments: \_\_\_\_\_
- 

- Resubmit Substitution Request; Provide more information in the following areas:
    - Provide proposal indicating amount of savings / credit to Owner
    - Bidding Contractor shall sign Bidder's Statement of Conformance
    - Bidding Subcontractor shall sign Bidder's Statement of Conformance
    - Other: \_\_\_\_\_
- 

- Substitution is not accepted:
  - Substitution Request received too late.
  - Substitution Request received directly from subcontractor or supplier.
  - Substitution Request not submitted in accordance with requirements.
  - Substitution Request Form is not properly executed.
  - Substitution Request does not indicate what item is being proposed.
  - Insufficient information submitted to facilitate proper evaluation.
  - Proposed product does not appear to comply with specified requirements.
  - Proposed product will require substantial revisions to Contract Documents.

**Architect**

Date: \_\_\_\_\_ By: \_\_\_\_\_

Architect has relied upon the information provided by the Contractor, and makes no claim as to the accuracy, completeness, or validity of such information. If an accepted substitution is later found to be not in compliance with the Contract Documents, Contractor shall provide the specified product.

**9. OWNER'S REVIEW AND ACTION**

- Substitution is accepted. Architect to prepare Change Order.
- Substitution is not accepted.
- Owner will pay Architect directly for redesign fees.
- Include Architect Additional Service fee for implementing the substitution in the Change Order.

Date: \_\_\_\_\_ By: \_\_\_\_\_  
(Owner's Representative)

END OF SECTION

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**01 26 13**

**REQUESTS FOR INFORMATION**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes administrative provisions for submitting and processing Requests for Information (RFIs) after execution of the Agreement:

1.2 DEFINITIONS

- A. RFI: Request from Contractor seeking Information or clarification of the Contract Documents.

1.3 REVIEW OF CONTRACT DOCUMENTS AND FIELD CONDITIONS

- A. General: Carefully study and compare Contract Documents with existing conditions at Project site and shall at once report in writing to Architect any error, inconsistency or omission discovered or any materials, systems, procedures, or methods of construction, either shown on the Drawings or specified, which the Contractor feels are incorrect, inadequate, obsolete, or unsuitable for purpose intended.
- B. Before starting each portion of the Work, carefully study and compare the various Drawings and other Contract Documents related to that portion of the Work, and information furnished by the Owner, take field measurements of existing conditions related to that portion of the Work, and observe conditions at the site.
- C. Any errors, discrepancies, inconsistencies, or omissions discovered shall be promptly reported to the Architect as a request for Information.
1. Contractor shall not proceed with the Work without written clarification from the Architect.
- D. In the case of conflicts or discrepancies between Drawings and Specifications, or within either Document not clarified by Addendum, promptly submit written request to the Architect as a request for Information.
1. Contractor shall not proceed with the Work without written clarification from the Architect.
- E. Contractor shall request clarification in sufficient time to avoid delays and increases in the Contract Sum.
- F. Contractor's failure to report discrepancies or omissions in the Contract Documents, or Contractor- or Subcontractor-generated assumptions, in lieu of Architect-issued clarifications regarding the intent of the Contract Documents, shall not be used a basis for future claims once the apparent discrepancies or omissions have been reconciled by appropriate Information issued by the Architect.

1.4 REQUESTS FOR INFORMATION (RFIS)

- A. Procedure: Immediately on discovery of the need for Information of the Contract Documents, and if not possible to request Information at Project meeting, prepare and submit an RFI in the form specified.
1. RFIs shall originate with Contractor. RFIs submitted by entities other than Contractor will be returned with no response.
  2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's

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work or work of subcontractors.

- B. Content of the RFI: Include a detailed, legible description of item needing Information and the following:
1. Project name
  2. Date
  3. Name of Contractor
  4. Name of Architect
  5. RFI number, numbered sequentially
  6. Specification Section number and title and related paragraphs, as appropriate
  7. Drawing number and detail references, as appropriate
  8. Field dimensions and existing conditions, as appropriate
  9. Contractor's suggested solution(s). If Contractor's solution(s) impact the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  10. Contractor's signature
  11. Attachments: Include drawings, descriptions, measurements, photos, Product Data, Shop Drawings, and other information necessary to fully describe items needing Information.
    - a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.
- C. Hard-Copy RFIs: CSI Form 13.2A included at end of this Section.
1. Identify each page of attachments with the RFI number and sequential page number.
- D. Software-Generated RFIs: Software-generated form with substantially the same content as indicated above.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- E. Architect's Action: Architect and PD will review each RFI, determine action required, and return it. Allow three working days for Architect's response for each RFI. RFIs received after 1:00 p.m. will be considered as received the following working day. If more time or more information is needed, the RFI should be returned by the Architect within the 3 day period, stating such.
1. The following RFIs will be returned without action:
    - a. Requests for approval of submittals
    - b. Requests for approval of substitutions
    - c. Requests for coordination information already indicated in the Contract Documents
    - d. Requests for adjustments in the Contract Time or the Contract Sum
    - e. Requests for Information of Architect's actions on submittals
    - f. Incomplete RFIs or RFIs with numerous errors
  2. Architect's action may include a request for additional information, in which case Architect's time for response will start again.
  3. Architect's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
    - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.
  4. RFIs involving request for remedial action to correct nonconforming work, which are returned in more than fourteen working days, are not eligible for Contractor's request for an increase in Contract Sum or an extension of Contract Time.
  5. Where any action or response falls due on a Saturday, Sunday, or legal holiday, such action or response shall be considered due on the next business day which is not a Saturday, Sunday or a legal holiday.

- 
- F. On receipt of Architect's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within ten days if Contractor disagrees with response.
- G. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit updated log at each Construction Progress Meeting. Provide software log with not less than the following:
1. Project name
  2. Name and address of Contractor
  3. Name and address of Architect
  4. RFI number including RFIs that were dropped and not submitted
  5. RFI description
  6. Date the RFI was submitted.
  7. Date Architect's response was received
  8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate

**PART 2 PRODUCTS (NOT USED)****PART 3 EXECUTION**

## 3.1 ATTACHMENTS

- A. Refer to Section 01 26 13x for Request for Information, CSI Form 13.2A.

END OF SECTION



# REQUEST FOR INTERPRETATION

Project: \_\_\_\_\_

R.F.I. Number: \_\_\_\_\_

\_\_\_\_\_

From: \_\_\_\_\_

To: \_\_\_\_\_

Date: \_\_\_\_\_

\_\_\_\_\_

A/E Project Number: \_\_\_\_\_

Re: \_\_\_\_\_

Contract For: \_\_\_\_\_

Specification Section:

Paragraph:

Drawing Reference:

Detail:

Request:

Signed by:

Date:

Response:

Attachments

Response From:

To:

Date Rec'd:

Date Ret<sup>rd</sup>:

Signed by:

Date:

Copies:  Owner  Consultants  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_  File

**01 31 00**

**PROJECT MANAGEMENT AND COORDINATION**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General project coordination procedures.
  - 2. Coordination Drawings.
  - 3. Administrative and supervisory personnel.
  - 4. Conservation.
  - 5. Project meetings.
- B. Related Sections include Division 01, Section "Requests for Information" for administrative procedures for handling RFIs.

1.2 COORDINATION

- A. Coordination: Coordinate construction operations included in various Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, which depend on each other for proper installation, connection, and operation.
  - 1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
  - 2. Coordinate installation of different components with other contractors to ensure maximum accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
  - 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.
- B. If necessary, prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
  - 1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.
- C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to:
  - 1. Preparation of Contractor's Construction Schedule
  - 2. Preparation of the Schedule of Values
  - 3. Installation and removal of temporary facilities and controls
  - 4. Delivery and processing of submittals
  - 5. Progress meetings
  - 6. Pre-installation conferences
  - 7. Project closeout activities
- D. Conservation: Coordinate construction activities to ensure that operations are carried out

with consideration given to conservation of energy, water, and materials.

1. Salvage materials and equipment involved in performance of, but not actually incorporated into, the Work.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Refer to Section 01 31 06.
- B. Staff Names: Within 15 days of starting construction operations, submit a list of principal staff assignments, including superintendent and other personnel in attendance at Project site. Identify individuals and their duties and responsibilities; list addresses and telephone numbers, including home and office telephone numbers. Provide names, addresses, and telephone numbers of individuals assigned as standbys in the absence of individuals assigned to Project.
  1. Post copies of list in Project meeting room, in temporary field office, and by each temporary telephone.

### 1.4 ADMINISTRATIVE AND SUPERVISORY PERSONNEL

- A. General: In addition to Project superintendent, provide other administrative and supervisory personnel as required for proper performance of the Work.

### 1.5 PROJECT MEETINGS

- A. General: Contractor shall schedule and conduct weekly meetings with subcontractor's foremen and regular Project progress meetings/conferences with Project Manager and Architect at Project site, unless otherwise indicated.
  1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting dates and times minimum of five business days prior to meeting date.
  2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  3. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner, Project Manager, and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later 15 days after execution of the Agreement. Hold the conference at Project site or another convenient location. Conduct the meeting to review responsibilities and personnel assignments.
  1. Attendees: Authorized representatives of Owner, Architect, and their consultants; Contractor and its superintendent; major subcontractors; manufacturers; suppliers; and other concerned parties shall attend the conference. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Discuss items of significance that could affect progress, including the following:
    - a. Tentative construction schedule
    - b. Phasing
    - c. Critical work sequencing
    - d. Designation of responsible personnel
    - e. Procedures for processing field decisions and Change Orders
    - f. Procedures for processing Applications for Payment
    - g. Distribution of the Contract Documents
    - h. Submittal procedures
    - i. Preparation of Record Documents

- j. Use of the premises
  - k. Responsibility for temporary facilities and controls
  - l. Parking availability
  - m. Office, work, and storage areas
  - n. Equipment deliveries and priorities
  - o. First aid
  - p. Security
  - q. Progress cleaning
  - r. Working hours
  - s. Emerging Technologies and Procedures
  - t. Inspection required at Substantial Completion for Texas Department of Licensing and Regulations requirements for Texas Accessibility Standards compliance. Refer to Section 01 77 00.
- C. Preinstallation Conferences: Conduct a preinstallation conference at Project site before each construction activity that requires coordination with other construction.
- 1. Attendees: Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect of scheduled meeting dates.
  - 2. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
    - a. Contract Documents
    - b. Options
    - c. Related Change Orders
    - d. Submittals
    - e. Review of mockups
    - f. Possible conflicts
    - g. Compatibility problems
    - h. Time schedules
    - i. Weather limitations
    - j. Manufacturer's written recommendations
    - k. Warranty requirements
    - l. Compatibility of materials
    - m. Acceptability of substrates
    - n. Temporary facilities and controls
    - o. Space and access limitations
    - p. Regulations of authorities having jurisdiction
    - q. Testing and inspecting requirements
    - r. Required performance results
    - s. Protection of construction and personnel
  - 3. Record significant conference discussions, agreements, and disagreements.
  - 4. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
- D. Progress Meetings: Conduct progress meetings at weekly intervals. Coordinate dates of meetings with preparation of payment requests.
- 1. Attendees: In addition to representatives of Owner and Architect, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 2. Agenda: Review and correct or approve minutes of previous progress meeting. Review other items of significance that could affect progress. Include topics for

discussion as appropriate to status of Project.

- a. Contractor's Construction Schedule: Review progress since the last meeting. Determine whether each activity is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
- b. Review present and future needs of each entity present, including the following:
  - 1) Two week look ahead schedule
  - 2) Interface requirements
  - 3) Sequence of operations
  - 4) Status of submittals
  - 5) Deliveries
  - 6) Off-site fabrication
  - 7) Access
  - 8) Site utilization
  - 9) Temporary facilities and controls
  - 10) Work hours
  - 11) Progress cleaning
  - 12) Status of correction of deficient items
  - 13) Field observations
  - 14) RFIs.
  - 15) Status of proposal requests
  - 16) Pending changes
  - 17) Change Orders
  - 18) Documentation of information for payment requests.
3. Reporting: Distribute minutes of the meeting to each party present and to parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.
  - a. Schedule Updating: Revise Contractor's Construction Schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with the report of each meeting.

**PART 2 PRODUCTS** - Not applicable to this Section

**PART 3 EXECUTION** - Not applicable to this Section

END OF SECTION

**01 32 00**

**CONSTRUCTION PROGRESS DOCUMENTATION**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
  - 1. Preliminary Construction Schedule
  - 2. Contractor's Construction Schedule
  - 3. Submittals Schedule
  - 4. Daily construction reports
  - 5. Material location reports
  - 6. Field condition reports
  - 7. Special reports
  
- B. Related Sections include the following:
  - 1. Division 01, Section "Payment Procedures" for submitting the Schedule of Values
  - 2. Division 01, Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes
  - 3. Division 01, Section "Submittal Procedures" for submitting schedules and reports
  - 4. Division 01, Section "Photographic Documentation" for submitting construction photographs

**1.2 DEFINITIONS**

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
  - 1. Critical activities are activities on the critical path. They must start and finish on the planned early start and finish times.
  - 2. Predecessor activity is an activity that must be completed before a given activity can be started.
  
- B. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of Project.
  
- C. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration and contains no float.
  
- D. Event: The starting or ending point of an activity.
  
- E. Float: The measure of leeway in starting and completing an activity.
  - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.
  - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the following activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.

- F. Fragnet: A partial or fragmentary network that breaks down activities into smaller activities for greater detail.
- G. Major Area: A story of construction, a separate building, a separate wing, a major department, or a similar significant construction element.
- H. Milestone: A key or critical point in time for reference or measurement.
- I. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships.

### 1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:
  - 1. Scheduled date for first submittal
  - 2. Specification Section number and title
  - 3. Submittal category (action or informational)
  - 4. Name of subcontractor
  - 5. Description of the Work covered
  - 6. Scheduled date for Architect's final release or approval
- C. Preliminary Construction Schedule: Submit two printed copies; one a single sheet of reproducible media, and one a print.
- D. Contractor's Construction Schedule: Submit two printed copies of initial schedule, one a reproducible print and one a blue- or black-line print, large enough to show entire schedule for entire construction period.
  - 1. Submit an electronic copy of schedule, as required by owner. Include type of schedule (Initial or Updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit three printed copies of each of the following computer-generated reports. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float.
  - 1. Activity Report: List of all activities sorted by activity number and then early start date, or actual start date if known.
  - 2. Logic Report: List of preceding and succeeding activities for all activities, sorted in ascending order by activity number and then early start date, or actual start date if known.
  - 3. Total Float Report: List of all activities sorted in ascending order of total float.
  - 4. Earnings Report: Compilation of Contractor's total earnings from commencement of the Work until most recent Application for Payment.
- F. Daily Construction Reports: Submit two copies at weekly intervals.
- G. Material Location Reports: Submit two copies at monthly intervals.
- H. Field Condition Reports: Submit two copies at time of discovery of differing conditions.
- I. Special Reports: Submit two copies at time of unusual event.

#### 1.4 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
1. Review software limitations and content and format for reports.
  2. Verify availability of qualified personnel needed to develop and update schedule.
  3. Discuss constraints, including phasing, work stages, area separations, and interim milestones.
  4. Review delivery dates for Owner-furnished products.
  5. Review time required for review of submittals and resubmittals.
  6. Review requirements for tests and inspections by independent testing and inspecting agencies.
  7. Review time required for completion and startup procedures.
  8. Review and finalize list of construction activities to be included in schedule.
  9. Review submittal requirements and procedures.
  10. Review procedures for updating schedule.

#### 1.5 COORDINATION

- A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.
- B. Coordinate Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
1. Secure time commitments for performing critical elements of the Work from parties involved.
  2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

### **PART 2 PRODUCTS**

#### 2.1 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.
  2. Initial Submittal: Submit concurrently with preliminary bar-chart schedule. Include submittals required during the first 60 days of construction. List those required to maintain orderly progress of the Work and those required early because of long lead time for manufacture or fabrication.
  3. Final Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.
  4. Submittals Schedule shall be submitted as one of the conditions precedent to the Architect releasing CAD files for Contractor's use. Refer to Division 01 Section "Submittal Procedures" and Appendix 'A' – Electronic Drawing File Transfer Agreement Form, attached thereto.

#### 2.2 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Procedures: Comply with procedures contained in AGC's "Construction Planning &

Scheduling."

- B. Computer Software: Prepare schedules using a program that has been developed specifically to manage construction schedules.
- C. Time Frame: Extend schedule from date established for commencement of the Work.
  - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- D. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
  - 1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
  - 2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
  - 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
  - 4. Startup and Testing Time: Include not less than 14 days for startup and testing.
  - 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's administrative procedures necessary for certification of Substantial Completion.
- E. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
  - 1. Work under More Than One Contract: Include a separate activity for each contract.
  - 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
  - 3. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary of Work." Delivery dates indicated stipulate the earliest possible delivery date. Indicate latest possible delivery date that will not affect critical path.
  - 4. Work Restrictions: Show the effect of the following items on the schedule:
    - a. Coordination with existing construction
    - b. Limitations of continued occupancies
    - c. Uninterruptible services
    - d. Use of premises restrictions
    - e. Provisions for future construction
    - f. Seasonal variations
    - g. Environmental control
  - 5. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
    - a. Subcontract awards
    - b. Submittals
    - c. Purchases
    - d. Mockups
    - e. Fabrication
    - f. Sample testing
    - g. Deliveries
    - h. Installation
    - i. Tests and inspections
    - j. Adjusting
    - k. Curing

- l. Minimum 90-day drying time of concrete floors prior to installation of floor finishes (Refer to Section 09 05 65)
        - m. Pre-installation moisture and alkalinity testing for non-breathable floor finishes (Refer to Section 09 05 65)
        - n. Startup and placement into final use and operation
  - 6. Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
    - a. Structural completion
    - b. Permanent space enclosure
    - c. Completion of mechanical installation
    - d. Completion of electrical installation
    - e. Substantial Completion
- F. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.
- G. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
  - 1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.
- H. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using fragnets to demonstrate the effect of the proposed change on the overall project schedule.

### 2.3 PRELIMINARY CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit preliminary horizontal bar-chart-type construction schedule within seven days of date established for commencement of the work.
- B. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first 60 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

### 2.4 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM SCHEDULE)

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. CPM Schedule: Prepare Contractor's Construction Schedule using a CPM network analysis diagram.
  - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 30 days after date established for commencement of the Work.
  - 2. Conduct educational workshops to train and inform key Project personnel, including subcontractors' personnel, in proper methods of providing data and using CPM schedule information.
  - 3. Establish procedures for monitoring and updating CPM schedule and for reporting progress. Coordinate procedures with progress meeting and payment request dates.
  - 4. Use "one workday" as the unit of time.
- C. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the preliminary network diagram, prepare a skeleton network to identify probable critical paths.

1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    - a. Preparation and processing of submittals
    - b. Purchase of materials
    - c. Delivery
    - d. Fabrication
    - e. Installation
  2. Processing: Process data to produce output data or a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often as necessary to produce the CPM schedule within the limitations of the Contract Time.
  3. Format: Mark the critical path. Locate the critical path near center of network; locate paths with most float near the edges.
    - a. Subnetworks on separate sheets are permissible for activities clearly off the critical path.
- D. Initial Issue of Schedule: Prepare initial network diagram from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:
1. Contractor or subcontractor and the Work or activity
  2. Description of activity
  3. Principal events of activity
  4. Immediate preceding and succeeding activities
  5. Early and late start dates
  6. Early and late finish dates
  7. Activity duration in workdays
  8. Total float or slack time
  9. Average size of workforce
  10. Dollar value of activity (coordinated with the Schedule of Values)
- E. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
1. Identification of activities that have changed
  2. Changes in early and late start dates
  3. Changes in early and late finish dates
  4. Changes in activity durations in workdays
  5. Changes in the critical path
  6. Changes in total float or slack time
  7. Changes in the Contract Time
  8. Schedule early completion of areas in accordance with Phasing requirements. Refer to Section 01 11 00.
- F. Value Summaries: Prepare two cumulative value lists, sorted by finish dates.
1. In first list, tabulate activity number, early finish date, dollar value, and cumulative dollar value.
  2. In second list, tabulate activity number, late finish date, dollar value, and cumulative dollar value.
  3. In subsequent issues of both lists, substitute actual finish dates for activities completed as of list date.
  4. Prepare list for ease of comparison with payment requests; coordinate timing with progress meetings.
    - a. In both value summary lists, tabulate "actual percent complete" and "cumulative value completed" with total at bottom.
    - b. Submit value summary printouts one week before each regularly scheduled progress meeting.

## 2.5 REPORTS

- A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
1. List of subcontractors at Project site
  2. List of separate contractors at Project site
  3. Approximate count of personnel at Project site
  4. High and low temperatures and general weather conditions
  5. Accidents
  6. Meetings and significant decisions
  7. Unusual events (refer to special reports)
  8. Stoppages, delays, shortages, and losses
  9. Meter readings and similar recordings
  10. Emergency procedures
  11. Orders and requests of authorities having jurisdiction
  12. Change Orders received and implemented
  13. Construction Change Directives received
  14. Services connected and disconnected
  15. Equipment or system tests and startups
  16. Partial Completions and occupancies
  17. Substantial Completions authorized
- B. Material Location Reports: At monthly intervals, prepare a comprehensive list of materials delivered to and stored at Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
- C. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Submit with a request for information in accordance with provisions of Section 01 26 13. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.6 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report electronically (as required by owner) to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Owner in advance when these events are known or predictable.

## PART 3 EXECUTION

### 3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.
1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule including a two week "look ahead" concurrently with the report of each such meeting.

2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
  3. As the Work progresses, indicate Actual Completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Architect, Owner, separate contractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
1. Post copies in Project meeting rooms and temporary field offices.
  2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION

**01 32 33**

**PHOTOGRAPHIC DOCUMENTATION**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final completion construction photographs.
  - 4. Demonstration and training video recordings.
- B. Related Sections include the following:
  - 1. Division 01, Section "Submittal Procedures" for submitting photographic documentation.
  - 2. Division 01, Section "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
  - 3. Division 01, Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
  - 4. Division 31, Section "Site Clearing" for photographic documentation before site clearing operations can commence.

1.2 INFORMATIONAL SUBMITTALS

- A. FAA Requirements:
  - 1. Current FAA Certified Drone Pilot License according to 14 CFR 107, Subpart C – Remote Pilot Certification.
  - 2. Current FAA Registration if drone weighs more than 0.55 pounds
- B. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph and video recording. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- C. Construction Photographs: Submit image files of each photographic view within three days of taking photographs.
  - 1. Digital Camera: Minimum sensor digital or high definition.
  - 2. Format: Minimum 1600 by 1200 pixels, 400 dpi minimum, in unaltered original files, with same aspect ratio as the sensor, uncropped, date- and time- stamped, in folder named by date of photograph, accompanied by key plan file.
  - 3. Identification: Provide the following information with each image description in file metadata tag:
    - a. Name of Project
    - b. Name and address of photographer
    - c. Name of Architect
    - d. Name of Contractor
    - e. Date photograph was taken
    - f. Description of vantage point, indicating location, direction (by

- compass point), and elevation or story of construction
      - g. Unique sequential identifier keyed to accompanying key plan
  - D. Construction Photographs: Submit approved electronic media and photo views concurrent with Application for Payment.
    - 1. Format shall be owner approved electronic media.
    - 2. Identification: Provide the following information: properties of the submitted electronic media (example below).
      - a. Name of Project
      - b. Name of Architect
      - c. Name of Contractor
      - d. Date photograph was taken
      - e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      - f. Unique sequential identifier keyed to accompanying key plan.
  - E. Video Recordings: Submit two copies of each video recording within seven days of recording. Coordinate with Owner for all final media submissions.
    - 1. Submit video recordings in digital video format acceptable to Owner.
    - 2. Identification: For each copy (electronic or disc), provide the following information:
      - a. Name of Project
      - b. Name of Architect
      - c. Name of Contractor
      - d. Date video recording was made
      - e. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
      - f. Weather conditions at time of recording.
- 1.3 ON MONTHLY BASIS, PROVIDE AERIAL PHOTOS FROM TWO DIFFERENT VIEWS AND DELIVER TO LSCS.
  - A. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting required to produce clear, well-lit photographs without obscuring shadows.
- 1.4 USAGE RIGHTS
  - A. Obtain and transfer copyright usage rights from photographer to Owner for unlimited reproduction of photographic documentation.

## **PART 2 PRODUCTS**

### **2.1 PHOTOGRAPHIC MEDIA**

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 6.0 megapixels, and at an image resolution of not less than 1600 by 1200 pixels.
- B. Digital Video Recording Format: Provide high-resolution, digital video disc in format acceptable to Owner.
  - 1. Recording quality shall be adequate to create photographic prints to be made from individual frames.

## **PART 3 EXECUTION**

### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
  - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
  
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
  - 1. Date and Time: Include date and time in filename for each image.
  - 2. Field Office Images: Maintain one set of images in Owner approved media format in the field office at Project site, available at all times for reference. Identify images same as for those submitted to Architect.
  
- C. Preconstruction Photographs: Before commencement of site clearing, excavation and demolition, take color print and digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Flag excavation areas and construction limits before taking construction photographs.
  - 2. Take twelve photographs to show existing conditions adjacent to property before starting the Work.
  - 3. Take twelve photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
  - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
  
- D. Periodic Construction Photographs: Take 12 color print and digital photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.
  
- E. Monthly UAV Drone Progressions:
  - 1. Comply with the safety requirements of 14 CFR 107. Include both panoramic and aerial video of the entire project captured monthly.
  - 2. Do not fly the drone higher than 400 feet.
  - 3. Photograph the 8 cardinal directions around the site perimeter and one top down, edited for proper exposure for allowing view of the entire site.
  - 4. Use the following personnel for all drone progressions:
    - a. Remote Pilot in Command: Responsible for the operation of the small unmanned aircraft system.
    - b. Visual Observer: Maintain unaided sight and position of small unmanned aircraft during flight.
  
- F. Final Completion Construction Photographs: Take twelve color photographs after date of Substantial Completion for submission as Project Record Documents. Architect will direct photographer for desired vantage points.
  
- G. Additional Photographs: Architect may issue requests for additional photographs, in addition to periodic photographs specified. Additional photographs will be paid for by Change Order and are not included in the Contract Sum.
  - 1. Three days notice will be given, where feasible.
  - 2. In emergency situations, take additional photographs within 24 hours of request.
  - 3. Circumstances that could require additional photographs include, but are not limited to, the following:

- a. Special events planned at Project site.
- b. Immediate follow-up when on-site events result in construction damage or losses.
- c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
- d. Substantial Completion of a major phase or component of the Work.
- e. Extra record photographs at time of final acceptance.
- f. Owner's request for special publicity photographs.

### 3.2 CONSTRUCTION VIDEO RECORDINGS

- A. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of construction. Display continuous running time and date. At start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- B. Preconstruction Videotape: Before starting site clearing, excavation, and selective site demolition, record videotape of Project site and surrounding properties from different vantage points, as directed by Architect.
  1. Flag excavation areas and construction limits before recording construction videotapes.
  2. Show existing conditions adjacent to Project site before starting the Work.
  3. Show existing buildings either on or adjoining Project site to accurately record physical conditions prior to the start of site clearing, excavation, and selective site demolition.
  4. Show protection efforts by Contractor.
- C. Periodic Construction Video Recordings: Record video recording monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded. Minimum recording time shall be a minimum of 30 minutes(s) to 24 hours.

END OF SECTION

**01 33 00**

**SUBMITTAL PROCEDURES**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other miscellaneous submittals.

1.2 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires Architect's responsive action.
- B. Informational Submittals: Written information that does not require Architect's approval. Submittals may be rejected for not complying with requirements.

1.3 PROVISION AND USE OF ELECTRONIC FILES

- A. General: Electronic CAD files of the Contract Drawings will NOT be furnished by Architect for Contractor's use in preparing submittals unless procedures stated within the attached Appendix A are agreed to by all parties and all parties sign the Agreement Form, and the Contractor properly prepares and submits the Submittals Schedule as indicated in Division 01, Section "Construction Progress Documentation."
- B. Release of electronic drawing files are conditional upon the following:
1. The drawings represented in the CAD files are not Contract Documents.
  2. Files generally available for transfer will be limited to an impediments file as described in the Agreement.
  3. Only one set of electronic drawing files will be furnished; Contractor assumes responsibility for distributing pertinent files to the various subcontractors.
  4. The electronic drawing files have been developed without the assistance or specific expertise of the individual subcontractors and installers, and therefore do not account for or incorporate means, methods, shop standards, and routing economies required by individual subcontractors for the scope of work required by the finished Work.
  5. Modifications to the information and routings of the selected components shown on the electronic drawing files may be required and are the responsibility of the Contractor. All modifications are part of the scope of Work of this Project and shall be provided at no additional cost to Owner.
  6. Contractor and subcontractors agree that electronic drawing files are not fit for any particular purpose, including, but not limited to quantity take-offs, pricing, development of a building information model (BIM), clash detection, construction sequencing, or the manufacture of any building component or system.
  7. There are no assurances that the electronic drawing files will be usable by the Contractor's and subcontractors' systems, infrastructure, or software; and that the files may be subject to anomalies, errors, viruses, malware, or other unintended defects.
- C. Limitations of Electronic Drawing File Transfer Agreement:
1. Agreement Form applies to Architectural Drawings only. If Contractor desires electronic drawing files for Drawings prepared by one of Architect's consultants, Contractor may contact consultant directly to obtain such files.
  2. Contractor shall recognize that various consultants retained by the Architect for this

Project, or retained separately by the Owner, may have agreements that differ from that included in Appendix A, and may have differing costs and procedures involved with obtaining electronic drawing files.

3. Architect makes no assertion that the Architect's or Owner's consultants will furnish electronic files of their Drawings. Additionally, not all Drawings may be available electronically.

#### 1.4 SUBMITTAL PROCEDURES

- A. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
  1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
  2. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
    - a. Architect reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- B. Submittals Schedule: Comply with requirements in Division 01 Section "Construction Progress Documentation" for list of submittals and time requirements for scheduled performance of related construction activities.
  1. Contractor shall become familiar with submittal requirements specified in Division 01 and in each discipline's documents to develop a complete schedule of submittals as described in Division 01 Section 32 00.
- C. Processing Time: Allow enough time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal.
  1. Initial Review: Allow 15 calendar days for initial review of each submittal. Allow additional time if processing must be delayed to permit coordination with subsequent submittals. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Concurrent Review: Where concurrent review of submittals by Architect's consultants, Owner, or other parties is required, allow 15 calendar days for initial review of each submittal.
  3. If intermediate submittal is necessary, process it in same manner as initial submittal.
  4. Allow 15 calendar days for processing each resubmittal.
  5. Unless otherwise indicated, where any action or submittal falls due on a Saturday, Sunday, or legal holiday, such action or submittal shall be considered due on the next business day which is not a Saturday, Sunday or a legal holiday.
  6. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing.
- D. Identification: Place a permanent label or title block on each submittal for identification.
  1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 4 X 5 inches (100 by 125 mm) on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information on label for processing and recording action taken:
    - a. Project name
    - b. Date
    - c. Name and address of Architect
    - d. Name and address of Contractor
    - e. Name and address of subcontractor
    - f. Name and address of supplier

- g. Name of manufacturer
  - h. Unique identifier, including revision number
  - i. Number and title of appropriate Specification Section
  - j. Drawing number and detail references, as appropriate
  - k. Other necessary identification.
- E. Deviations: Highlight, encircle, or otherwise identify deviations from the Contract Documents on submittals. Provide accompanying detailed written explanation for deviation.
- F. Additional Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions of the Contract Documents, initial submittal may serve as final submittal.
- 1. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
  - 2. Additional copies submitted for maintenance manuals will not be marked with action taken and will be returned.
- G. Transmittal: Package each submittal individually and appropriately for transmittal and handling. Transmit each submittal using approved transmittal form which is attached. Architect will return submittals, without review received from sources other than Contractor.
- 1. On an attached separate sheet, prepared on Contractor's letterhead, record relevant information, requests for data, revisions other than those requested by Architect on previous submittals, and deviations from requirements of the Contract Documents, including minor variations and limitations. Include the same label information as the related submittal.
  - 2. Include Contractor's certification stating that information submitted complies with requirements of the Contract Documents.
  - 3. Transmittal Form: Sample form included in Appendix C at end of Section. Final Submittal format to be approved by Owner.
- H. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- I. Use for Construction: Use only final submittals with mark indicating "Approved" or "Approved as Noted" action taken by Architect in connection with construction.

## **PART 2 PRODUCTS**

### **2.1 ACTION SUBMITTALS**

- A. General: Prepare and submit Action Submittals required by individual Specification Sections.
- 1. Number of Copies:
    - a. Submit four copies of each submittal, unless otherwise indicated. Architect will retain one copy and return three copies. Mark up and retain one returned copy as a Project Record Document. Copies shall be distributed as follows:
      - 1) One copy for Contractor's use.
      - 2) One copy for subcontractor's use.
      - 3) One copy shall be provided to the Owner. Furnish Owner with final copy designated as "Approved" or "Approved as Noted" only.
      - 4) Contractor shall be responsible for providing additional copies as required for additional personnel, field use, etc.
    - b. Submit one extra set of submittals to be retained by Architect's consultant, where the consultant was delegated design responsibility for that item of work to which submittal pertains.

- c. Submit one extra set of applicable Division 23 related submittals for Commissioning of HVAC system.
    2. Surplus copies in addition to those indicated above will not be marked up by the Architect or consultant.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
  1. If information must be specially prepared for submittal because standard printed data are not suitable for use, submit as Shop Drawings, not as Product Data.
  2. Mark each copy of each submittal to show which products and options are applicable. Submittals not clearly identifying which products and options are being proposed will be returned without action.
  3. Include the following information, as applicable:
    - a. Manufacturer's written recommendations
    - b. Manufacturer's product specifications
    - c. Standard color charts
    - d. Manufacturer's catalog cuts
    - e. Wiring diagrams showing factory-installed wiring
    - f. Compliance with recognized trade association standards
    - g. Compliance with recognized testing agency standards
    - h. Application of testing agency labels and seals
    - i. Notation of coordination requirements
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
  1. Submittals containing reproduction of Contract Drawings are not considered Shop Drawings and will be returned without action. Any delay due to such rejection will not be grounds for an extension of Contract Time.
  2. Preparation: Include the following information, as applicable:
    - a. Dimensions
    - b. Identification of products
    - c. Fabrication and installation drawings
    - d. Roughing-in and setting diagrams
    - e. Wiring diagrams showing field-installed wiring, including power, signal, and control wiring
    - f. Templates and patterns
    - g. Schedules
    - h. Design calculations
    - i. Compliance with specified standards
    - j. Notation of coordination requirements
    - k. Notation of dimensions established by field measurement
  3. Wiring Diagrams: Differentiate between manufacturer-installed and field-installed wiring.
  4. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches(215 by 280 mm) but no larger than 30 by 42 inches (750 by 1050 mm).
  5. Number of Copies: Submit one correctable, translucent, reproducible print and three opaque prints of each submittal. Architect will return the marked-up reproducible print and two opaque prints for Contractor to make copies and distribute.
- D. Samples: Prepare physical units of materials or products, including the following:
  1. Comply with requirements in Division 01 Section "Quality Assurance Requirements" for mockups.
  2. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.

- a. Submit color charts showing actual colors (photographic representations or reproductions will not be accepted).
  3. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from the same material to be used for the Work, cured and finished in manner specified, and physically identical with the product proposed for use, and that show full range of color and texture variations expected. Samples include, but are not limited to, the following: partial sections of manufactured or fabricated components; small cuts or containers of materials; complete units of repetitively used materials; swatches showing color, texture, and pattern; color range sets; and components used for independent testing and inspection.
  4. Preparation: Mount, display, or package Samples in manner specified to facilitate review of qualities indicated. Prepare Samples to match Architect's sample where so indicated. Attach label on unexposed side that includes the following:
    - a. Generic description of Sample
    - b. Product name or name of manufacturer
    - c. Sample source
  5. Additional Information: On an attached separate sheet, prepared on Contractor's letterhead, provide the following:
    - a. Size limitations
    - b. Compliance with recognized standards
    - c. Availability
    - d. Delivery time
  6. Submit Samples for review of kind, color, pattern, and texture for a final check of these characteristics with other elements and for a comparison of these characteristics between final submittal and actual component as delivered and installed.
    - a. If variation in color, pattern, texture, or other characteristic is inherent in the product represented by a Sample, submit at least three sets of paired units that show approximate limits of the variations.
    - b. Refer to individual Specification Sections for requirements for Samples that illustrate workmanship, fabrication techniques, and details of assembly, connections, operation, and similar construction characteristics.
  7. Number of Samples for Initial Selection: Submit one full set of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Architect will return submittal with options selected.
  8. Number of Samples for Verification: Submit three sets of Samples. Architect will retain two sample sets; remainder will be returned. Mark up and retain one returned Sample set as a Project Record Sample.
    - a. Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.
  9. Coordinate with Architect for location of sample delivery to Architect's office or to Project site.
  10. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
    - a. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
- E. Product Schedule or List: Prepare a written summary indicating types of products required for the Work and their intended location. Include the following information in tabular form:
  1. Type of product. Include unique identifier for each product.
  2. Number and name of room or space.
  3. Location within room or space.

- F. Submittals Schedule: Comply with requirements in Division 01, Section "Construction Progress Documentation."
- G. Application for Payment: Comply with requirements in Division 01, Section "Payment Procedures."
- H. Schedule of Values: Comply with requirements in Division 01, Section "Payment Procedures."
- I. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Use CSI Form 1.5A (see attached Appendix B). Include the following information in tabular form:
  - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
  - 2. Number and title of related Specification Section(s) covered by subcontract.
  - 3. Drawing number and detail references, as appropriate, covered by subcontract.

## 2.2 INFORMATIONAL SUBMITTALS

- A. General: Prepare and submit Informational Submittals required by other Specification Sections.
  - 1. Number of Copies:
    - a. Submit two copies of each submittal, unless otherwise indicated. Architect will not return copies.
    - b. Submit one extra set of applicable Division 23 and other mechanical controls-related submittals for commissioning of HVAC System.
  - 2. Certificates and Certifications: Provide a notarized statement that includes signature of entity responsible for preparing certification.
    - a. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
  - 3. Test and Inspection Reports: Comply with requirements in Division 01 Section "Quality Assurance Requirements."
- B. Coordination Drawings: Refer to Division 01 Section 31 06.
- C. Contractor's Construction Schedule: Comply with requirements in Division 01, Section "Construction Progress Documentation."
- D. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- E. Certificates:
  - 1. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements. Submit record of Welding Procedure Specification (WPS) and Procedure Qualification Record (PQR) on AWS forms. Include names of firms and personnel certified.
  - 2. Installer Certificates: Prepare written statements on manufacturer's letterhead certifying that Installer complies with requirements and, where required, is authorized for this specific Project.
  - 3. Manufacturer Certificates: Prepare written statements on manufacturer's letterhead certifying that manufacturer complies with requirements. Include evidence of manufacturing experience where required.
  - 4. Product Certificates: Prepare written statements on manufacturer's letterhead

- certifying that product complies with requirements.
5. Material Certificates: Prepare written statements on manufacturer's letterhead certifying that material complies with requirements.
- F. Test Reports:
1. Material Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
  2. Product Test Reports: Prepare written reports indicating current product produced by manufacturer complies with requirements. Base reports on evaluation of tests performed by manufacturer and witnessed by a qualified testing agency, or on comprehensive tests performed by a qualified testing agency.
  3. Preconstruction Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of tests performed before installation of product, for compliance with performance requirements.
  4. Compatibility Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of compatibility tests performed before installation of product. Include written recommendations for primers and substrate preparation needed for adhesion.
  5. Field Test Reports: Prepare reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting results of field tests performed either during installation of product or after product is installed in its final location, for compliance with requirements.
- G. Maintenance Data: Prepare written and graphic instructions and procedures for operation and normal maintenance of products and equipment. Comply with requirements in Division 01 Section "Closeout Procedures."
- H. Manufacturer's Instructions: Prepare written or published information that documents manufacturer's recommendations, guidelines, and procedures for installing or operating a product or equipment. Include name of product and name, address, and telephone number of manufacturer. Include the following, as applicable:
1. Preparation of substrates
  2. Required substrate tolerances
  3. Sequence of installation or erection
  4. Required installation tolerances
  5. Required adjustments
  6. Recommendations for cleaning and protection
- I. Manufacturer's Field Reports: Prepare written information documenting factory-authorized service representative's tests and inspections. Include the following, as applicable:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.

- 6. Statement whether conditions, products, and installation will affect warranty.
- 7. Other required items indicated in individual Specification Sections.
- J. Insurance Certificates and Bonds: Prepare written information indicating current status of insurance or bonding coverage. Include name of entity covered by insurance or bond, limits of coverage, amounts of deductibles, if any, and term of the coverage.
- K. Construction Photographs: Comply with requirements in Division 01 Section "Construction Progress Documentation."
- L. Material Safety Data Sheets: Not a required submittal, nor subject to Architect's review or approval, since Contractor remains solely responsible for job site safety controls, procedures, and programs. Submit information directly to Owner as part of Closeout Submittals unless otherwise directed.
  - 1. If submitted to Architect, Architect will not review this information and will return it with no action taken.

### 2.3 DELEGATED DESIGN

- A. Design Data: Prepare written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.
- B. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.
  - 1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Architect.
- C. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit three copies of a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional.
  - 1. Indicate that products and systems comply with performance and design criteria in the Contract Documents. Include list of codes, loads, and other factors used in performing these services.

## PART 3 EXECUTION

### 3.1 CONTRACTOR'S REVIEW

- A. Review each submittal and check for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
  - 1. Ensure submittal is specifically required by the Contract Documents. Submittals not required shall not be submitted and will not be processed or reviewed by the Architect.
  - 2. Verify:
    - a. Field measurements
    - b. Field construction criteria
    - c. Catalog numbers and similar data
    - d. Proper interface with adjacent or related work
  - 3. Coordinate each submittal with requirements of Work of Contract Documents

4. Assign submittal number in accordance with the following:
    - a. Six-digit Specification Section number
    - b. Two-digit number representing product, material, or item in referenced Section to which submittal pertains (01, 02, 03, 04, etc.).
    - c. Single letter representing submittal sequence ("A" for initial submittal, "B" for first re-submittal, "C" for second re-submittal, etc.).
  5. Each specified material, product, or item shall be submitted individually, as a separate, uniquely identified submittal. Assembled booklets containing multiple products or systems will not be permitted, and will be returned without action.
- B. Approval Stamp: Stamp each submittal with a uniform, approval stamp. Include Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.
1. Language on Contractor's submittal review stamp shall be consistent with the requirements of the Agreement and General Conditions.
  2. A stamp containing language which defers or assigns Contractor's responsibilities to subcontractor will not be permitted; submittals bearing a stamp with such language will be returned without action. Any delay due to such rejection will not be grounds for an extension of Contract Time.

### 3.2 ARCHITECT'S ACTION

- A. General: Architect will not review submittals that do not bear Contractor's approval stamp and will return them without action.
- B. Action Submittals: Architect will review each submittal, make marks to indicate corrections or modifications required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action taken, as follows:
1. Approved
  2. Approved as Noted
  3. Revise and Resubmit
  4. Not Approved
  5. No Action Required by Architect
- C. Informational Submittals: Architect will review each submittal and will not return it, or will reject and return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- D. Partial submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents will not be reviewed and may be discarded.

END OF SECTION

**01 40 00**

**QUALITY REQUIREMENTS**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
  - 1. Specific quality-assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
  - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.
  - 3. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, Commissioning Authority, or authorities having jurisdiction are not limited by provisions of this Section.
  - 4. Specific test and inspection requirements are not specified in this Section.

1.2 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.
- C. Mockups: Full-size physical assemblies that are constructed on-site. Mockups are constructed to verify selections made under Sample submittals; to demonstrate aesthetic effects and, where indicated, qualities of materials and execution; to review coordination, testing, or operation; to show interface between dissimilar materials; and to demonstrate compliance with specified installation tolerances. Mockups are not Samples. Unless otherwise indicated, approved mockups establish the standard by which the Work will be judged.
  - 1. Integrated Exterior Mockups: Mockups of the exterior envelope erected separately from the building but on Project site, consisting of multiple products, assemblies, and subassemblies.
  - 2. Room Mockups: Mockups of typical interior spaces complete with wall, floor, and ceiling finishes, doors, windows, millwork, casework, specialties, furnishings and equipment, and lighting.
- D. Preconstruction Testing: Tests and inspections performed specifically for Project before products and materials are incorporated into the Work, to verify performance or compliance

with specified criteria.

- E. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- F. Source Quality-Control Testing: Tests and inspections that are performed at the source, e.g., plant, mill, factory, or shop.
- G. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- H. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- I. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
  - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade(s).

### 1.3 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer conflicting requirements that are different, but apparently equal, to Architect for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.4 ACTION SUBMITTALS

- A. Shop Drawings: For integrated exterior mockups, provide plans, sections, and elevations, indicating materials and size of mockup construction.
  - 1. Indicate manufacturer and model number of individual components.
  - 2. Provide axonometric drawings for conditions difficult to illustrate in two dimensions.

### 1.5 INFORMATIONAL SUBMITTALS

- A. Contractor's Quality-Control Plan: For quality-assurance and quality-control activities and responsibilities.
- B. Qualification Data: For Contractor's quality-control personnel.
- C. Testing Agency Qualifications: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.
- D. Schedule of Tests and Inspections: Prepare in tabular form and include the following:
  - 1. Specification Section number and title.

2. Entity responsible for performing tests and inspections.
3. Description of test and inspection.
4. Identification of applicable standards.
5. Identification of test and inspection methods.
6. Number of tests and inspections required.
7. Time schedule or time span for tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

#### 1.6 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice to Proceed, and not less than five days prior to preconstruction conference. Submit in format acceptable to Architect. Identify personnel, procedures, controls, instructions, tests, records, and forms to be used to carry out Contractor's quality-assurance and quality-control responsibilities. Coordinate with Contractor's construction schedule.
- B. Quality-Control Personnel Qualifications: Engage qualified full-time personnel trained and experienced in managing and executing quality-assurance and quality-control procedures similar in nature and extent to those required for Project.
  1. Project quality-control manager may also serve as Project superintendent.
- C. Submittal Procedure: Describe procedures for ensuring compliance with requirements through review and management of submittal process. Indicate qualifications of personnel responsible for submittal review.
- D. Testing and Inspection: In quality-control plan, include a comprehensive schedule of Work requiring testing or inspection, including the following:
  1. Contractor-performed tests and inspections including subcontractor-performed tests and inspections. Include required tests and inspections and Contractor-elected tests and inspections.
  2. Special inspections required by authorities having jurisdiction and indicated on the "Statement of Special Inspections."
  3. Owner-performed tests and inspections indicated in the Contract Documents, including tests and inspections indicated to be performed by the Commissioning Authority.
- E. Continuous Inspection of Workmanship: Describe process for continuous inspection during construction to identify and correct deficiencies in workmanship in addition to testing and inspection specified. Indicate types of corrective actions to be required to bring work into compliance with standards of workmanship established by Contract requirements and approved mockups.
- F. Monitoring and Documentation: Maintain testing and inspection reports including log of approved and rejected results. Include work Architect has indicated as nonconforming or defective. Indicate corrective actions taken to bring nonconforming work into compliance with requirements. Comply with requirements of authorities having jurisdiction.

#### 1.7 REPORTS AND DOCUMENTS

- A. Test and Inspection Reports: Prepare and submit certified written reports specified in other Sections. Include the following:
  1. Date of issue.
  2. Project title and number.
  3. Name, address, and telephone number of testing agency.

4. Dates and locations of samples and tests or inspections.
  5. Names of individuals making tests and inspections.
  6. Description of the Work and test and inspection method.
  7. Identification of product and Specification Section.
  8. Complete test or inspection data.
  9. Test and inspection results and an interpretation of test results.
  10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
  11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
  12. Name and signature of laboratory inspector.
  13. Recommendations on retesting and re-inspecting.
- B. Manufacturer's Technical Representative's Field Reports: Prepare written information documenting manufacturer's technical representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of technical representative making report.
  2. Statement on condition of substrates and their acceptability for installation of product.
  3. Statement that products at Project site comply with requirements.
  4. Summary of installation procedures being followed, whether they comply with requirements and, if not, what corrective action was taken.
  5. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  6. Statement whether conditions, products, and installation will affect warranty.
  7. Other required items indicated in individual Specification Sections.
- C. Factory-Authorized Service Representative's Reports: Prepare written information documenting manufacturer's factory-authorized service representative's tests and inspections specified in other Sections. Include the following:
1. Name, address, and telephone number of factory-authorized service representative making report.
  2. Statement that equipment complies with requirements.
  3. Results of operational and other tests and a statement of whether observed performance complies with requirements.
  4. Statement whether conditions, products, and installation will affect warranty.
  5. Other required items indicated in individual Specification Sections.
- D. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

## 1.8 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that is similar in material, design, and extent to those indicated for this Project.
- F. Specialists: Certain Specification Sections require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.
  - 1. Requirements of authorities having jurisdiction shall supersede requirements for specialists.
- G. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 329; and with additional qualifications specified in individual Sections; and, where required by authorities having jurisdiction, that is acceptable to authorities.
  - 1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
  - 2. NVLAP: A testing agency accredited according to NIST's National Voluntary Laboratory Accreditation Program.
- H. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- J. Preconstruction Testing: Where testing agency is indicated to perform preconstruction testing for compliance with specified requirements for performance and test methods, comply with the following:
  - 1. Contractor responsibilities include the following:
    - a. Provide test specimens representative of proposed products and construction.
    - b. Submit specimens in a timely manner with sufficient time for testing and analyzing results to prevent delaying the Work.
    - c. Provide sizes and configurations of test assemblies, mockups, and laboratory mockups to adequately demonstrate capability of products to comply with performance requirements.
    - d. Build site-assembled test assemblies and mockups using installers who will perform same tasks for Project.
    - e. Build laboratory mockups at testing facility using personnel, products, and methods of construction indicated for the completed Work.
    - f. When testing is complete, remove test specimens, assemblies, mockups, and laboratory mockups; do not reuse products on Project.
  - 2. Testing Agency Responsibilities: Submit a certified written report of each test, inspection, and similar quality-assurance service to Architect and Commissioning Authority, with copy to Contractor. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from the Contract Documents.

- K. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:
  - 1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
  - 2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
  - 3. Employ supervisory personnel who will oversee mockup construction. Employ workers that will be employed during the construction at Project.
  - 4. Demonstrate the proposed range of aesthetic effects and workmanship.
  - 5. Obtain Architect's approval of mockups before starting work, fabrication, or construction.
    - a. Allow seven days for initial review and each re-review of each mockup.
  - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 7. Demolish and remove mockups when directed unless otherwise indicated.
- L. Integrated Exterior Mockups: Refer to Section 01 43 39 "Mockups" for requirements.
- M. Room Mockups: Refer to Section 01 43 39 "Mockups" for requirements.
- N. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.

#### 1.9 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
  - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
  - 2. Payment for these services will be made from testing and inspecting allowances, as authorized by Change Orders.
  - 3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.
- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
  - 1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
  - 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
    - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
  - 3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
  - 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
  - 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
  - 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

- C. **Manufacturer's Field Services:** Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Section 01 33 00 "Submittal Procedures."
- D. **Manufacturer's Technical Services:** Where indicated, engage a manufacturer's technical representative to observe and inspect the Work. Manufacturer's technical representative's services include participation in pre-installation conferences, examination of substrates and conditions, verification of materials, observation of Installer activities, inspection of completed portions of the Work, and submittal of written reports.
- E. **Retesting/Re-inspecting:** Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- F. **Testing Agency Responsibilities:** Cooperate with Architect, Commissioning Authority and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
  - 1. Notify Architect, Commissioning Authority, and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
  - 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
  - 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
  - 4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
  - 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
  - 6. Do not perform any duties of Contractor.
- G. **Associated Services:** Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
  - 1. Access to the Work.
  - 2. Incidental labor and facilities necessary to facilitate tests and inspections.
  - 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
  - 4. Facilities for storage and field curing of test samples.
  - 5. Delivery of samples to testing agencies.
  - 6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
  - 7. Security and protection for samples and for testing and inspecting equipment at Project site.
- H. **Coordination:** Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
  - 1. Schedule times for tests, inspections, obtaining samples, and similar activities.
- I. **Schedule of Tests and Inspections:** Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents as a component of Contractor's quality-control plan. Coordinate and submit concurrently with Contractor's construction schedule. Update as the Work progresses.

1. Distribution: Distribute schedule to Owner, Architect, Commissioning Authority, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

#### 1.10 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Conducted by a qualified testing agency as required by authorities having jurisdiction, as indicated in individual Specification Sections, and as follows:
  1. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  2. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect and Commissioning Authority with copy to Contractor and to authorities having jurisdiction.
  3. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies?
  4. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  5. Retesting and re-inspecting corrected work.

### **PART 2 PRODUCTS (NOT USED)**

### **PART 3 EXECUTION**

#### 3.1 TEST AND INSPECTION LOG

- A. Test and Inspection Log: Prepare a record of tests and inspections. Include the following:
  1. Date test or inspection was conducted.
  2. Description of the Work tested or inspected.
  3. Date test or inspection results were transmitted to Architect.
  4. Identification of testing agency or special inspector conducting test or inspection.
- B. Maintain log at Project site. Post changes and revisions as they occur. Provide access to test and inspection log for Architect's, Commissioning Authority's, reference during normal working hours.

#### 3.2 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
  1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract Document requirements for cutting and patching in Division 01 Section "Execution."
- B. Protect construction exposed by or for quality-control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION

**01 50 00**

**TEMPORARY FACILITIES AND CONTROLS**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section includes requirements for temporary facilities and controls, including temporary utilities, support facilities, and security and protection facilities. Also reference Owners Special Conditions.
- B. Support Facilities, including but not limited to the following:
  - 1. Field offices
  - 2. Storage and fabrication sheds
  - 3. Temporary roads and paving
  - 4. Traffic controls
  - 5. Parking
  - 6. Dewatering facilities and drains
  - 7. Project identification and temporary signs
  - 8. Waste disposal facilities
  - 9. Lifts and hoists
  - 10. Temporary elevator usage
  - 11. Temporary stairs
  - 12. Construction aids and miscellaneous services and facilities
- C. Temporary Utilities, including but not limited to the following:
  - 1. Sewers and drainage
  - 2. Water service and distribution
  - 3. Sanitary facilities, including toilets and drinking-water facilities
  - 4. Heating and cooling facilities
  - 5. Ventilation and humidity control
  - 6. Electric power service
  - 7. Lighting
  - 8. Telephone service
  - 9. Electronic communications service
- D. Security and Protection Facilities, including but not limited to the following:
  - 1. Environmental protection
  - 2. Storm water control
  - 3. Pest control
  - 4. Site enclosure fence
  - 5. Security enclosure and lockup
  - 6. Security cameras where required by Owner
  - 7. Barricades, warning signs, and lights
  - 8. Temporary means of egress
  - 9. Covered walkways
  - 10. Temporary enclosures
  - 11. Temporary partitions
  - 12. Temporary fire protection

E. Related Sections include the following:

1. Division 01, Section "Summary of Work" for work restrictions and limitations on utility interruptions.
2. Division 01, Section "Temporary Tree and Plant Protection" for protection of trees and vegetation in work areas.
3. Division 01, Section "Erosion and Sedimentation Control" for temporary measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to undisturbed areas and to adjacent properties.

1.2 DEFINITIONS:

A. Permanent Enclosure: As determined by Architect, includes as a minimum, the following:

1. Permanent or temporary roofing is complete, insulated, and weathertight, including parapets and roof edge terminations.
2. Exterior walls are insulated, weathertight, and UV-resistant.
3. All openings are closed with permanent construction or substantial weathertight temporary closures.
4. Permanent enclosure envelope shall be capable of retaining controlled interior temperature and humidity levels.

1.3 USE CHARGES

- A. General: Installation and removal of and use charges for temporary facilities shall be included in the Contract Sum unless otherwise indicated. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction. Contractor shall be accountable for wasteful usage of Owner provided utilities.
- B. Water and Sewer Service from Existing System: Water from Owner's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.
- C. Electric Power Service: Pay electric power service use charges for electricity used by all entities for construction operations.

1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage including delivery, handling, and storage provisions for materials subject to water absorption or water damage, discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water damaged Work.
1. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, plastering, and terrazzo grinding, and describe plans for dealing with water and dirt from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.

1.5 QUALITY ASSURANCE

- A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.
- B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each

temporary utility before use. Obtain required certifications and permits.

- C. Accessible Temporary Egress: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

## 1.6 PROJECT CONDITIONS

- A. Temporary Use of Permanent Facilities: Engage installer of each permanent service to assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner's acceptance, regardless of previously assigned responsibilities.
- B. Conditions of Use: The following conditions apply to use of temporary services and facilities by all parties engaged in the Work:
  - 1. Keep temporary services and facilities clean and neat.
  - 2. Relocate temporary services and facilities as required by progress of the Work.
  - 3. At earliest feasible time, when acceptable to Owner, change over from use of temporary service to use of permanent service.

## PART 2 PRODUCTS

### 2.1 MATERIALS

- A. General: Provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by Architect. Provide materials suitable for use intended.
- B. Portable Chain-Link Fencing: Minimum 2-inch, 0.148-inch- thick, galvanized steel, chain-link fabric fencing; minimum 6 feet high with galvanized steel pipe posts; minimum 2-3/8-inch- OD line posts and 2-7/8-inch- OD corner and pull posts, with 1-5/8-inch- OD top and bottom rails.
  - 1. Provide concrete or galvanized steel bases for supporting posts.
- C. Wood Enclosure Fence: Plywood, 8 feet high, framed with four 2-by-4-inch rails, with preservative-treated wood posts spaced not more than 8 feet apart.
- D. Lumber and Plywood: Comply with requirements in Division 06, Section "Miscellaneous Carpentry,"

### 2.2 TEMPORARY FACILITIES

- A. Field Offices: Prefabricated with lockable entrances, operable windows, and serviceable finishes; heated and air conditioned; on foundations adequate for normal loading.
- B. Common-Use Field Office: Provide an insulated, weathertight, air-conditioned field office for use as a common facility by all personnel engaged in construction activities; of sufficient size to accommodate required office personnel and meetings of 15 persons at Project site. Keep office clean and orderly. Furnish and equip offices as follows:
  - 1. Furniture required for Project-site documents including file cabinets, plan tables, plan racks, and bookcases.
  - 2. Water cooler and private toilet complete with water closet, lavatory, and medicine cabinet with mirror.
  - 3. Provide a room of not less than 240 sq. ft. for Project meetings. Furnish room with conference table, 15 folding chairs, and minimum 4-foot- square tack board.
  - 4. Provide resilient floor covering, painted gypsum wallboard or wood paneled walls, and acoustical ceiling. Provide operable windows with adjustable blinds and insect

- 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 6. Provide fluorescent light fixtures capable of maintaining average illumination of 20 fc at desk height. Provide 110- to 120-V duplex outlets spaced at not more than 12-foot intervals, 1 per wall in each room.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment involved, including temporary utility services. Sheds may be open shelters or fully enclosed spaces within building or elsewhere on-site.
- 1. Construct framing, sheathing, and siding using fire-retardant-treated lumber and plywood.
  - 2. Paint exposed lumber and plywood with exterior-grade acrylic-latex emulsion over exterior primer.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Hand carried, portable, UL rated. Provide class and extinguishing agent as indicated or a combination of extinguishers of NFPA-recommended classes for exposures.
- 1. Comply with NFPA 10 and NFPA 241 for classification, extinguishing agent, and size required by location and class of fire exposure.
- B. Self-Contained Toilet Units: Single-occupant units of chemical, aerated recirculation or combustion type; vented; fully enclosed with a glass-fiber-reinforced polyester shell or similar nonabsorbent material.
- C. Drinking-Water Fixtures: Containerized, bottled-water drinking-water units, including paper cup supply.
- 1. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F .
- D. HVAC Equipment: Unless Owner authorizes use of permanent heating system, provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.
- 1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
  - 2. Heating Units: Listed and labeled, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use for type of fuel being consumed.
  - 3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction and clean HVAC system as required in Division 01, Section "Closeout Procedures".
- E. Electrical Outlets: Properly configured, NEMA-polarized outlets to prevent insertion of 110- to 120-V plugs into higher-voltage outlets; equipped with ground-fault circuit interrupters, reset button, and pilot light.
- F. Power Distribution System Circuits: Where permitted and overhead and exposed for surveillance, wiring circuits, not exceeding 125-V ac, 20-A rating, and lighting circuits may be nonmetallic sheathed cable.

## PART 3 EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.
- B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

### 3.2 TEMPORARY UTILITY INSTALLATION

- A. General: Install temporary service or connect to existing service. Where utility company provides only part of the service, provide the remainder with matching, compatible materials and equipment. Comply with utility company recommendations.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
  - 2. Provide adequate capacity at each stage of construction. Before temporary utility is available, provide trucked-in services.
  - 3. Obtain easements to bring temporary utilities to Project site where Owner's easements cannot be used for that purpose.
- B. Uninterrupted utility services to the existing facilities are imperative. Provide temporary utilities as necessary during required change over times for each utility to ensure uninterrupted service.
- C. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds, and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off-site in a lawful manner.
  - 1. Filter out excessive soil, construction debris, chemicals, oils, and similar contaminants that might clog sewers or pollute waterways before discharge.
  - 2. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. After heavy use, restore normal conditions promptly.
  - 3. Provide temporary filter beds, settlement tanks, separators, and similar devices to purify effluent to levels acceptable to authorities having jurisdiction.
- D. Water Service: Use of Owner's existing water service facilities will be permitted, as long as facilities are cleaned and maintained in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
  - 1. As soon as water is required at each level, extend service to form a temporary water- and fire-protection standpipe. Provide distribution piping. Space outlets so water can be reached with a 100-foot (30-m) hose. Provide one hose at each outlet.
  - 2. Where installations below an outlet might be damaged by spillage or leakage, provide a drip pan of suitable size to minimize water damage. Drain accumulated water promptly from pans.
- E. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking-water fixtures. Comply with regulations and health codes for type, number, location, operation, and maintenance of fixtures and facilities.
  - 1. Disposable Supplies: Provide toilet tissue, paper towels, paper cups, and similar disposable materials for each facility. Maintain adequate supply. Provide covered waste containers for disposal of used material.
  - 2. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy.
  - 3. Wash Facilities: Install wash facilities supplied with potable water at convenient locations for personnel who handle materials that require wash up. Dispose of drainage properly. Supply cleaning compounds appropriate for each type of material

- handled.
  - a. Provide safety showers, eyewash fountains, and similar facilities for convenience, safety, and sanitation of personnel.
  - 4. Drinking-Water Facilities: Provide bottled-water, drinking-water units.
    - a. Where power is accessible, provide electric water coolers to maintain dispensed water temperature at 45 to 55 deg F.
  - 5. Locate toilets and drinking-water fixtures so personnel need not walk more than two stories vertically or 200 feet horizontally to facilities.
- F. Heating and Cooling: Provide temporary heating and cooling required by
- G. Ventilation and Humidity Control: Provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment from that specified that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.
- 1. Provide dehumidification systems when required to reduce substrate moisture levels to level required to allow installation or application of finishes.
- H. Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload-protected disconnecting means, automatic ground-fault interrupters, and main distribution switchgear.
- 1. Connect temporary service to Owner's existing power source, as directed by electric company officials.
- I. Electric Distribution: Provide receptacle outlets adequate for connection of power tools and equipment complete with ground fault protection.
- 1. Provide waterproof connectors to connect separate lengths of electrical power cords if single lengths will not reach areas where construction activities are in progress. Do not exceed safe length-voltage ratio.
  - 2. Provide warning signs at power outlets other than 110 to 120 V.
  - 3. Provide metal conduit, tubing, or metallic cable for wiring exposed to possible damage. Provide rigid steel conduits for wiring exposed on grades, floors, decks, or other traffic areas.
  - 4. Provide metal conduit enclosures or boxes for wiring devices.
  - 5. Provide 4-gang outlets, spaced so 100-foot extension cord can reach each area for power hand tools and task lighting. Provide a separate 125-V ac, 20-A circuit for each outlet.
- J. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations and traffic conditions.
- 1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  - 2. Install exterior-yard site lighting that will provide adequate illumination for construction operations, traffic conditions, and signage visibility when the Work is being performed.
- K. Telephone Service: Provide temporary telephone service throughout construction period for common-use facilities used by all personnel engaged in construction activities. Install separate telephone line for each field office and first-aid station.
- 1. Provide additional telephone lines for the following:
    - a. In field office with more than two occupants, install a telephone for each additional occupant or pair of occupants.
    - b. Provide a dedicated telephone line for each facsimile machine

- c. Provide high-speed internet service for each computer with modem in each field office.
    - d. Provide a separate telephone line for Owner's use.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police Department
    - b. Fire Department
    - c. Ambulance service
    - d. Contractor's home office
    - e. Architect's office
    - f. Engineers' offices
    - g. Owner's office
    - h. Principal subcontractors' field and home offices
  3. Provide a portable cellular telephone with voice-mail capability for superintendent's use in making and receiving telephone calls when away from field office.
- L. Electronic Communication (E-mail) Service: Provide temporary electronic communication service, including electronic mail, in common-use facilities.
  1. Provide broadband in primary field office.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
  1. Locate field offices, storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access.
  2. Provide construction for temporary offices, shops, and sheds located within construction area or within 30 feet of building lines that is noncombustible according to ASTM E 136. Comply with NFPA 241.
  3. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate to support loads and to withstand exposure to traffic during construction period. Locate temporary roads and paved areas in same location as permanent roads and paved areas. Extend temporary roads and paved areas, within construction limits indicated, as necessary for construction operations.
  1. Coordinate elevations of temporary roads and paved areas with permanent roads and paved areas.
  2. Prepare subgrade and install sub base and base for temporary roads and paved areas according to Division 31, Section "Excavation and Fill."
  3. Recondition base after temporary use, including removing contaminated material, re-grading, proof rolling, compacting, and testing.
- C. Traffic Controls: Provide temporary traffic controls at junction of temporary roads with public roads. Include warning signs for public traffic and "STOP" signs for entrance onto public roads. Comply with requirements of authorities having jurisdiction.
  1. Protect existing site improvements to remain including curbs, pavement, and utilities.
  2. Maintain access for fire-fighting equipment and access to fire hydrants.
- D. Dewatering Facilities and Drains: Comply with requirements in applicable Division 31 for temporary drainage and dewatering facilities and operations not directly associated with construction activities included in individual Sections. Where feasible, use same facilities. Maintain Project site, excavations, and construction free of water.
  1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining property nor endanger permanent Work or temporary facilities.

2. Before connection and operation of permanent drainage piping system, provide temporary drainage where roofing or similar waterproof deck construction is completed.
- E. Project Identification and Temporary Signs: Prepare Project identification and other signs in sizes indicated. Install signs where indicated to inform public and persons seeking entrance to Project. Do not permit installation of unauthorized signs.
  1. Engage an experienced sign painter to apply graphics for Project identification signs. Comply with details indicated.
  2. Prepare temporary signs to provide directional information to construction personnel and visitors.
  3. Construct signs of exterior-type Grade B-B high-density concrete form overlay plywood in sizes and thicknesses indicated. Support on posts or framing of preservative-treated wood or steel.
  4. Paint sign panel and applied graphics with exterior-grade alkyd gloss enamel over exterior primer.
- F. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Containerize and clearly label hazardous, dangerous, or unsanitary waste materials separately from other waste. Comply with Division 01, Section "Common Execution Requirements" for progress cleaning requirements.
  1. If required by authorities having jurisdiction, provide separate containers, clearly labeled, for each type of waste material to be deposited.
  2. Develop a waste management plan for Work performed on Project. Indicate types of waste materials Project will produce and estimate quantities of each type. Provide detailed information for on-site waste storage and separation of recyclable materials. Provide information on destination of each type of waste material and means to be used to dispose of all waste materials.
- G. Janitorial Services: Provide janitorial services on a weekly basis for temporary offices, first-aid stations, toilets, wash facilities, lunchrooms, and similar areas. General cleaning shall be done by Contractor daily.
- H. Lifts and Hoists: Provide facilities for hoisting materials and personnel. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- I. Temporary Elevator Use: See Division 14 elevator Section for temporary use of new elevators.
- J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

### 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

- A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects. Avoid using tools and equipment that produce harmful noise. Restrict use of noisemaking tools and equipment to hours that will minimize complaints from persons or firms near Project site.
- B. Storm water Control: Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm

water from heavy rains. Comply with Division 01 Section, "Erosion and Sedimentation Control".

- C. Tree and Plant Protection: Comply with requirements specified in Division 01, Section "Temporary Tree and Plant Protection."
- D. Pest Control: Before deep foundation work has been completed, retain a local exterminator or pest-control company to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests. Engage this pest-control service to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials. Maintain site free of food scraps which might attract pests.
- E. Site Enclosure Fence: Before construction operations begin, install heavy wire mesh or chain-link enclosure fence with lockable entrance gates. Locate where indicated, or enclose entire Project site or portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs, and other animals from easily entering site except by entrance gates. Comply with Owner's Special Conditions, Project Fencing section 2.5.
  - 1. Set fence posts in compacted mixture of gravel and earth.
  - 2. Provide gates in sizes and at locations necessary to accommodate delivery vehicles and other construction operations.
  - 3. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Provide Owner with one set of keys.
- F. Security Enclosure and Lockup: Install substantial temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security.
- G. Barricades, Warning Signs, and Lights: Comply with standards and code requirements for erecting structurally adequate barricades. Paint with appropriate colors, graphics, and warning signs to inform personnel and public of possible hazard. Where appropriate and needed, provide lighting, including flashing red or amber lights.
  - 1. For safety barriers, sidewalk bridges, and similar uses, provide minimum 5/8-inch-thick exterior plywood.
- H. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- I. Temporary Enclosures: Provide temporary enclosures for protection of construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.
  - 1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.
  - 2. Vertical Openings: Close openings of 25 sq. ft. or less with plywood or similar materials.
  - 3. Horizontal Openings: Close openings in floor or roof decks and horizontal surfaces with load-bearing, wood-framed construction.
  - 4. Install tarpaulins securely using fire-retardant-treated wood framing and other materials.
  - 5. Where temporary wood or plywood enclosure exceeds 100 sq. ft. in area, use fire-retardant-treated material for framing and main sheathing.

- J. Temporary Fire Protection: Until fire-protection needs are supplied by permanent facilities, install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241.
1. Provide fire extinguishers, installed on walls on mounting brackets, visible and accessible from space being served, with sign mounted above.
    - a. Field Offices: Class A stored-pressure water-type extinguishers.
    - b. Other Locations: Class ABC dry-chemical extinguishers or a combination of extinguishers of NFPA-recommended classes for exposures.
    - c. Locate fire extinguishers where convenient and effective for their intended purpose; provide not less than one extinguisher on each floor at or near each usable stairwell.
  2. Store combustible materials in containers in fire-safe locations.
  3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire-protection facilities, stairways, and other access routes for firefighting. Prohibit smoking in hazardous fire-exposure areas.
  4. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition.
  5. Permanent Fire Protection: At earliest feasible date in each area of Project, complete installation of permanent fire-protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
  6. Develop and supervise an overall fire-prevention and first-aid fire-protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.

### 3.5 MOISTURE AND MOLD CONTROL

- A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction. Remove and replace materials with mold.
- B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:
1. Protect porous materials from water damage.
  2. Protect stored and installed material from flowing or standing water.
  3. Keep porous and organic materials from coming into prolonged contact with concrete.
  4. Remove standing water from decks.
  5. Keep deck openings covered or dammed.
- C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:
1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
  2. Keep interior spaces reasonably clean and protected from water damage.
  3. Periodically collect and remove waste containing cellulose or other organic matter.
  4. Discard or replace water-damaged material.
  5. Do not install material that is wet.
  6. Discard, replace or clean stored or installed material that begins to grow mold.
  7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.
- D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:
1. Control moisture and humidity inside building by maintaining effective dry-in

- conditions.
  - 2. Use permanent HVAC system to control humidity.
  - 3. Comply with manufacturer's written instructions for temperature, relative humidity, and exposure to water limits.
- E. Wet and Water-Damaged Materials:
- 1. Hygroscopic materials that may support mold growth, including wood and gypsum-based products, that become wet during the course of construction and remain wet for 24 hours are considered defective.
  - 2. Measure moisture content of materials that have been exposed to moisture during construction operations or after installation. Record daily readings over a forty-eight hour period. Identify materials containing moisture levels higher than allowed. Report findings in writing to Architect.
  - 3. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

### 3.6 OPERATION, TERMINATION, AND REMOVAL

- A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.
- B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage caused by freezing temperatures and similar elements.
  - 1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation, and similar facilities on a 24-hour basis where required to achieve indicated results and to avoid possibility of damage.
  - 2. Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.
- C. Temporary Facility Changeover: Except for using permanent fire protection as soon as available, do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.
  - 1. Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.
  - 2. Remove temporary roads and paved areas not intended for or acceptable for integration into permanent construction. Where area is intended for landscape development, remove soil and aggregate fill that do not comply with requirements for fill or subsoil. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances that might impair growth of plant materials or lawns. Repair or replace street paving, curbs, and sidewalks at temporary entrances, as required by authorities having jurisdiction.
  - 3. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements in Division 01, Section "Closeout Procedures."

END OF SECTION

**01 60 00**

**PRODUCT REQUIREMENTS**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Sections include:
  - 1. Division 01 Section "Allowances" for products selected under an allowance.
  - 2. Division 01 Section "Alternates" for products selected under an alternate.
  - 3. Division 01 Section "Substitution Procedures" for requests for substitutions.
  - 4. Division 01 Section "References" for applicable industry standards for products specified.

1.2 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
  - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.
  - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
  - 3. Comparable Product: Product that is demonstrated and approved through submittal process to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.
- B. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.3 ACTION SUBMITTALS

- A. Comparable Product Requests: Submit request for consideration of each comparable product. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles. Note that no substitutions for convenience are allowed according to Division 01 Section "Substitutions."
  - 1. Include data to indicate compliance with the requirements specified in "Comparable Products" Article.
  - 2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a comparable product

request. Architect will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

- a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
- b. Use product specified if Architect does not issue a decision on use of a comparable product request within time allocated.

- B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

#### 1.5 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
  1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
  2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
  3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
  4. Inspect products on delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.
- C. Storage:
  1. Store products to allow for inspection and measurement of quantity or counting of units.
  2. Store materials in a manner that will not endanger Project structure.
  3. Store products that are subject to damage by the elements, under cover in a weather tight enclosure above ground, with ventilation adequate to prevent condensation.
  4. Protect foam plastic from exposure to sunlight, except to extent necessary for period of installation and concealment.
  5. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-protection requirements for storage.
  6. Protect stored products from damage and liquids from freezing.
  7. Provide a secure location and enclosure at Project site for storage of materials and equipment by Owner's construction forces. Coordinate location with Owner.

#### 1.6 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
  1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a

- particular product and specifically endorsed by manufacturer to Owner.
2. Special Warranty: Written warranty required by the Contract Documents to provide specific rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
  2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
  3. See other Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

## **PART 2 PRODUCTS**

### **2.1 PRODUCT SELECTION PROCEDURES**

- A. General Product Requirements: Provide products that comply with the Contract Documents, are undamaged and, unless otherwise indicated, are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
  2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
  3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
  4. Where products are accompanied by the term "as selected," Architect will make selection.
  5. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single manufacturer and product, provide the named product that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements. Comparable products or substitutions for Contractor's convenience will not be considered.
  3. Products:
    - a. Restricted List: Where Specifications include a list of names of both manufacturers and products, provide one of the products listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
  4. Manufacturers:
    - a. Restricted List: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements. Comparable products or substitutions for Contractor's convenience will be considered unless otherwise indicated.
  5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers and/or products, provide the specified or indicated product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and

other characteristics that are based on the product named. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product by one of the other named manufacturers.

- C. Visual Matching Specification: Where Specifications require "match Architect's sample", provide a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.
  - 1. If no product available within specified category matches and complies with other specified requirements, comply with requirements in Division 01 Section "Substitution Procedures" for proposal of product.
- D. Visual Selection Specification: Where Specifications include the phrase "as selected by Architect from manufacturer's full range" or similar phrase, select a product that complies with requirements. Architect will select color, gloss, pattern, density, or texture from manufacturer's product line that includes both standard and premium items.

## 2.2 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Architect will consider Contractor's request for comparable product when the following conditions are satisfied. Note that substitutions for convenience are not allowed according to Division 01 Section "Substitutions." If the following conditions are not satisfied, Architect may return requests without action, except to record noncompliance with these requirements:
  - 1. Evidence that the proposed product does not require revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
  - 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
  - 3. Evidence that proposed product provides specified warranty.
  - 4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
  - 5. Samples, if requested.

## **PART 3 EXECUTION** - Not applicable to this Section

END OF SECTION

**01 72 00**

**COMMON EXECUTION REQUIREMENTS**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. General installation of products.
  - 4. Coordination of Owner-installed products.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Sections include the following:
  - 1. Division 01 Section "Cutting and Patching" for procedural requirements for cutting and patching necessary for the installation or performance of other components of the Work.
  - 2. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.2 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For land surveyor to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
- B. Certificates: Submit certificate signed by land surveyor certifying that location and elevation of improvements comply with requirements.
- C. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.
- D. Certified Surveys: Submit two copies signed by land surveyor.
- E. Final Property Survey: Submit two copies showing the Work performed and record survey data.

1.3 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.

**PART 2 PRODUCTS – Not Applicable to this Section**

**PART 3 EXECUTION**

### 3.1 EXAMINATION

- A. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.
  - 1. Written Report: Provide a written report listing conditions detrimental to performance of any and all Work, include the following:
    - a. Description of the Work.
    - b. List of detrimental conditions, including substrates.
    - c. List of unacceptable installation tolerances.
    - d. Recommended corrections.
  - 2. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 3. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 4. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 5. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- B. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- C. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents, submit a request for information to Architect. Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents. Submit requests on CSI Form 13.2A, "Request for Information" form included at the end of in Division 01 Section "Substitutions."

### 3.3 CONSTRUCTION LAYOUT

- A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.
- B. General: Engage a land surveyor to lay out the Work using accepted surveying practices.
  - 1. Establish benchmarks and control points to set lines and levels at each story of construction and elsewhere as needed to locate each element of Project.
  - 2. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  - 3. Inform installers of lines and levels to which they must comply.
  - 4. Check the location, level and plumb, of every major element as the Work progresses.
  - 5. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  - 6. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

- C. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.
- D. Building Lines and Levels: Locate and lay out control lines and levels for structures, building foundations, column grids, and floor levels, including those required for mechanical and electrical work. Transfer survey markings and elevations for use with control lines and levels. Level foundations and piers from two or more locations.
- E. Record Log: Maintain a log of layout control work. Record deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used. Make the log available for reference by Architect.

### 3.4 FIELD ENGINEERING

- A. Identification: Owner will identify existing benchmarks, control points, and property corners.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
  - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Architect. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Architect before proceeding.
  - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Benchmarks: Establish and maintain a minimum of two permanent benchmarks on Project site, referenced to data established by survey control points. Comply with authorities having jurisdiction for type and size of benchmark.
  - 1. Record benchmark locations, with horizontal and vertical data, on Project Record Documents.
  - 2. Where the actual location or elevation of layout points cannot be marked, provide temporary reference points sufficient to locate the Work.
  - 3. Remove temporary reference points when no longer needed. Restore marked construction to its original condition.
- D. Certified Survey: On completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and site work.
- E. Final Property Survey: Prepare a final property survey showing significant features (real property) for Project. Include on the survey a certification, signed by land surveyor or professional engineer, that principal metes, bounds, lines, and levels of Project are accurately positioned as shown on the survey.
  - 1. Show boundary lines, monuments, streets, site improvements and utilities, existing improvements and significant vegetation, adjoining properties, acreage, grade contours, and the distance and bearing from a site corner to a legal point.
  - 2. Recording: At Substantial Completion, have the final property survey recorded by or with authorities having jurisdiction as the official "property survey."

### 3.5 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
  - 1. Make vertical work plumb and make horizontal work level.

2. Where space is limited, comply with provisions of Section 01 31 06. Install components to maximize space available for maintenance and ease of removal for replacement.
  3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
  4. Maintain minimum headroom clearance of 8 feet in spaces without a suspended ceiling.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produces harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
1. Mounting Heights: Where mounting heights are not indicated, request clarification and mount components at heights directed by Architect.
  2. Allow for building movement, including thermal expansion and contraction.
  3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 OWNER-INSTALLED PRODUCTS

- A. Site Access: Provide access to Project site for Owner's construction forces.
- B. Coordination: Coordinate construction and operations of the Work with work performed by Owner's construction forces, AV, IT, etc.
1. Construction Schedule: Inform Owner of Contractor's preferred construction schedule for Owner's portion of the Work. Adjust construction schedule based on a mutually agreeable timetable. Notify Owner if changes to schedule are required due to differences in actual construction progress.
  2. Preinstallation Conferences: Include Owner's construction forces at preinstallation conferences covering portions of the Work that are to receive Owner's work. Attend preinstallation conferences conducted by Owner's construction forces if portions of the Work depend on Owner's construction.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Assure there are no significant food matters in dumpster.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
  - 1. Remove liquid spills promptly.
  - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Cutting and Patching: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.
  - 1. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.
- H. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.
- I. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- J. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- K. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

### 3.8 STARTING AND ADJUSTING

- A. Manufacturer's representative shall be present for initial start up.
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust operating components for proper operation without binding. Adjust equipment for

proper operation.

- D. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

### 3.9 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

### 3.10 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."
  - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.
- E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION

**01 73 29**

**CUTTING AND PATCHING**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes procedural requirements for cutting and patching.

1.2 DEFINITIONS

- A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.
- B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.
- C. Cutting and patching is performed for coordination of the Work, to uncover Work for access or inspection, to obtain samples for testing, to permit alterations to be performed or for other similar purposes.
- D. Restoring or removing and replacing non-complying work is specified separately from cutting-and-patching, but may require cutting-and-patching operations as specified herein.

1.3 INFORMATIONAL SUBMITTALS

- A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:
  - 1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
  - 2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
  - 3. Products: List products to be used and firms or entities that will perform the Work.
  - 4. Dates: Indicate when cutting and patching will be performed.
  - 5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
  - 6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
  - 7. Architect's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.4 QUALITY ASSURANCE

- A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.
- B. Operational Elements: Do not cut and patch operating elements and related components in

a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-protection systems.
4. Control systems.
5. Communication systems.
6. Conveying systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

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

1. If possible, retain original Installer or fabricator to cut and patch exposed Work listed below. If it is impossible to engage original Installer or fabricator, engage another recognized, experienced, and specialized firm.
  - a. Processed concrete finishes.
  - b. Stonework and stone masonry.
  - c. Ornamental metal.
  - d. Matched-veneer woodwork.
  - e. Preformed metal panels.
  - f. Roofing.
  - g. Firestopping.
  - h. Window wall system.
  - i. Stucco and ornamental plaster.
  - j. Terrazzo.
  - k. Finished wood flooring.
  - l. Fluid-applied flooring.
  - m. Aggregate wall coating.
  - n. Wall covering.
  - o. HVAC enclosures, cabinets, or covers.

E. Cutting and Patching Conference: Before proceeding, meet at Project site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

## 1.5 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to

void existing warranties.

## **PART 2 PRODUCTS**

### **2.1 MATERIALS**

- A. General: Comply with requirements specified in other Sections of these Specifications.
- B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
  - 1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
  - 2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Temporary Support: Provide temporary support of Work to be cut.
- B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.
- C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.
- D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to avoid interruption of services to occupied areas.

### **3.3 PERFORMANCE**

- A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
- B. Execute cutting, fitting and patching, including excavation and fill, to complete work and to:
  - 1. Fit the several parts together to integrate with other work.
  - 2. Uncover work to install ill-timed work.
  - 3. Remove and replace defective and nonconforming work.
  - 4. Remove samples of installed work for testing.
  - 5. Provide openings in elements of work for penetrations of mechanical and electrical work.
  - 6. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
- C. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar

operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.
  3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
  4. Excavating and Backfilling: Comply with requirements in applicable Division 31 Sections where required by cutting and patching operations.
  5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
  6. Proceed with patching after construction operations requiring cutting are complete.
- D. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.
1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
  2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
    - a. Clean piping, conduit, and similar features before applying paint or other finishing materials.
    - b. Restore damaged pipe covering to its original condition.
  3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
    - a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
  4. Ceilings: Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
  5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
- E. Fire Rated Construction: At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material in accordance with Section 07 84 13, to full thickness of the penetrated element.
- F. Roofing: Where penetrations are made through the roof system to accommodate mechanical, electrical, or plumbing systems, or any other reason associated with the Work, repair in accordance with the original manufacturer's requirements. Install curbs, cants, flashing and other roof system components in accordance with Specifications within this Project Manual and recommendations by the manufacturer of the roof system presently in place. Return assembly to weather-tight condition. Also refer to Division 07 section on roof modifications or repairs.

- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION

**01 77 00**

**CLOSEOUT PROCEDURES**

**PART 1 GENERAL**

**1.1 SUMMARY**

- A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
1. Inspection procedures.
  2. Texas Accessibility Standards (TAS) inspection
  3. Warranties
  4. Instruction of Owner's personnel
  5. Final cleaning
  6. Owner's standard of care

**1.2 SUBSTANTIAL COMPLETION**

- A. "Substantial Completion" is the stage in the progress of Work when Work or designated portion thereof is sufficiently complete in accordance with Contract Documents so Owner can occupy or utilize Work for use which it is intended.
1. Work will not be considered suitable for Substantial Completion review until all systems and equipment are operational; all designated or required governmental inspections and certifications have been made and posted, designated instruction of Owner's personnel in operation of systems and equipment has been completed, operation and maintenance data has been satisfactorily turned over to the Owner, and all finishes are in place. In general, the only remaining Work shall be minor in nature, such that the Owner could occupy project or designated portion thereof on following day, and completion of Work by Contractor would not materially interfere or hamper Owner's normal business operations.
- B. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
  2. Advise Owner of pending insurance changeover requirements.
  3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs and photographic negatives, damage or settlement surveys, property surveys, and similar final record information.
  6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
  7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
  8. Complete startup testing of systems.
  9. Terminate and remove temporary facilities from Project site, along with mockups,

- construction tools, and similar elements.
  - 10. Advise Owner of changeover in heat and other utilities.
  - 11. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
  - 12. Complete final cleaning requirements, including touchup painting.
- C. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
- 1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.
  - 2. Results of completed inspection will form the basis of requirements for Final Completion.

### 1.3 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:
- 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
  - 2. Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
  - 3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
  - 4. Submit pest-control final inspection report and warranty.
  - 5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
  - 6. Submit test/adjust/balance records.
  - 7. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
- 1. Re-inspection: Request re-inspection when the Work identified in previous inspections as incomplete is completed or corrected.

### 1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Contractor that are outside the limits of construction. Use attached CSI Form, or substantially similar form, and forward to Architect at time of request for Substantial Completion inspection. Architect may use same form for Architect's supplemental items to Contractor.
- 1. Organize list of spaces in sequential order.
  - 2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
  - 3. Include the following information at the top of each page:

- a. Project name
- b. Date
- c. Name of Architect
- d. Name of Contractor
- e. Page number

#### 1.5 TEXAS ACCESSIBILITY STANDARD INSPECTION

- A. Provide inspection prior to Final Completion of facility in accordance with rules and regulation of the Texas Department of Licensing and Regulations (TDLR) for the purpose of determining compliance with the Texas Accessibility Standards. Inspector must be licensed with the Texas Department of Licensing and Regulations to perform the required inspection.
- B. Upon receipt of Inspector's report, immediately make corrections of any reported non-compliant items. Provide documentation to Owner of completed corrective measures.

#### 1.6 PROJECT RECORD DOCUMENTS

- A. Refer to Section 01 78 39.

#### 1.7 OPERATION AND MAINTENANCE MANUALS

- A. Refer to Section 01 78 23.

#### 1.8 WARRANTIES

- A. Refer to Section 01 78 36.

### **PART 2 PRODUCTS**

#### 2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

### **PART 3 EXECUTION**

#### 3.1 DEMONSTRATION AND TRAINING

- A. Refer to Section 01 79 00.

#### 3.2 FINAL CLEANING

- A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and anti-pollution regulations.
- B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program that is acceptable to the Owner and consistent with the Owner's standards of care. Comply with manufacturer's written instructions.
  - 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
    - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.

- b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
  - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
  - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
  - e. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.
  - f. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
  - g. Sweep concrete floors broom clean in unoccupied spaces.
  - h. Power-wash concrete paving and parking areas, and concrete decks of parking garages.
  - i. Vacuum carpet and similar soft surfaces, including millwork, removing debris and excess nap; shampoo if visible soil or stains remain.
  - j. Clean transparent materials, including mirrors and glass in doors and windows. Remove glazing compounds and other noticeable, vision-obscuring materials. Replace chipped or broken glass and other damaged transparent materials. Polish mirrors and glass, taking care not to scratch surfaces.
  - k. Remove labels that are not permanent.
  - l. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
    - 1) Do not paint over "UL" and similar labels, including mechanical and electrical nameplates.
  - m. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - n. Replace parts subject to unusual operating conditions.
  - o. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - p. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - q. Clean ducts, blowers, and coils if units were operated without filters during construction.
  - r. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency. Replace burned-out bulbs, and those noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.
  - s. Leave Project clean and ready for occupancy as acceptable to the Owner and their standards.
- C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.3 FORMS (REFERENCE):

- A. Section 01 77 00x.....Completion/Correction Form, CSI Form 14.1A.
- B. Section 01 77 00xx.....Project Close-Out Checklist

C. Section 01 77 00xxx.....Facilities Infrastructure Asset Inventory Form.

END OF SECTION

**01 78 23**

**OPERATION AND MAINTENANCE DATA**

**PART 1 GENERAL**

1.1 SUMMARY

- A. This Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
  - 1. Operation and maintenance documentation directory.
  - 2. Emergency manuals.
  - 3. Operation manuals for systems, subsystems, and equipment.
  - 4. Maintenance manuals for the care and maintenance of products, materials, and finishes, systems and equipment.
- B. Related Sections include the following:
  - 1. Division 01, Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
  - 2. Divisions 02 through 49 for specific operation and maintenance manual requirements for the Work in those Sections.

1.2 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.3 SUBMITTALS

- A. Ensure compliance with Uniform General and Supplemental Conditions.
- B. Initial Submittal: Submit 2 draft copies of each manual at least 15 days before requesting inspection for Substantial Completion. Include a complete operation and maintenance directory. Architect will return 1 copy of draft and mark whether general scope and content of manual are acceptable.
- C. Final Submittal: Submit 1 copy of each manual in final form at least 15 days before final inspection. Architect will return copy with comments within 15 days after final inspection.
  - 1. Correct or modify each manual to comply with Architect's comments. Submit one hard copy for Facilities and one electronic copy for FP&C (.pdf) of each corrected manual within 15 days of receipt of Architect's comments.

1.4 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

**PART 2 PRODUCTS**

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization. Include a section in the directory for each of the following:
  - 1. List of documents
  - 2. List of systems
  - 3. List of equipment
  - 4. Table of contents
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each emergency, operation, and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with the same designation used in the Contract Documents. If no designation exists, assign a designation according to ASHRAE Guideline 4, "Preparation of Operating and Maintenance Documentation for Building Systems".

## 2.2 MANUALS, GENERAL

- A. Organization. Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
  - 1. Title page
  - 2. Table of contents
  - 3. Manual contents
- B. Title Page. Enclose title page in transparent plastic sleeve. Include the following information:
  - 1. Subject matter included in manual
  - 2. Name and address of Project
  - 3. Name and address of Owner
  - 4. Date of submittal
  - 5. Name, address, and telephone number of Contractor
  - 6. Name and address of Architect
  - 7. Cross-reference to related systems in other operation and maintenance manuals
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
  - 1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
  - 1. Binders: Heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2 X 11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
    - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related

- components. Cross-reference other binders, if necessary, to provide essential information for proper operation or maintenance of equipment or system.
- b. Identify each binder on front and spine with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.
  3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software diskettes for computerized electronic equipment.
  4. Supplementary Text: Prepared on 8-1/2 X 11-inch, 20-lb/sf white bond paper.
  5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
    - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
    - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

### 2.3 EMERGENCY MANUALS

- A. Content: Organize manual into a separate section for each of the following:
  1. Type of emergency
  2. Emergency instructions
  3. Emergency procedures
- B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
  1. Fire
  2. Flood
  3. Gas leak
  4. Water leak
  5. Power failure
  6. Water outage
  7. System, subsystem, or equipment failure
  8. Chemical release or spill.
- C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- D. Emergency Procedures. Include the following, as applicable:
  1. Instructions on stopping
  2. Shutdown instructions for each type of emergency
  3. Operating instructions for conditions outside normal operating limits
  4. Required sequences for electric or electronic systems
  5. Special operating instructions and procedures

### 2.4 OPERATION MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
  1. System, subsystem, and equipment descriptions

2. Performance and design criteria if Contractor is delegated design responsibility
  3. Operating standards
  4. Operating procedures
  5. Operating logs
  6. Wiring diagrams
  7. Control diagrams
  8. Piped system diagrams
  9. Precautions against improper use
  10. License requirements including inspection and renewal dates
- B. Descriptions. Include the following:
1. Product name and model number
  2. Manufacturer's name
  3. Equipment identification with serial number of each component
  4. Equipment function
  5. Operating characteristics
  6. Limiting conditions
  7. Performance curves
  8. Engineering data and tests
  9. Complete nomenclature and number of replacement parts
- C. Operating Procedures. Include the following, as applicable:
1. Startup procedures
  2. Equipment or system break-in procedures
  3. Routine and normal operating instructions
  4. Regulation and control procedures
  5. Instructions on stopping
  6. Normal shutdown instructions
  7. Seasonal and weekend operating instructions
  8. Required sequences for electric or electronic systems
  9. Special operating instructions and procedures
- D. Systems and Equipment Controls: Describe the sequence of operation and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed and identify color-coding where required for identification.

## 2.5 PRODUCT MAINTENANCE MANUAL

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Product Information. Include the following, as applicable:
1. Product name and model number
  2. Manufacturer's name
  3. Color, pattern, and texture
  4. Material and chemical composition
  5. Reordering information for specially manufactured products

- D. Maintenance Procedures. Include manufacturer's written recommendations and the following:
  - 1. Inspection procedures
  - 2. Types of cleaning agents to be used and methods of cleaning
  - 3. List of cleaning agents and methods of cleaning detrimental to product
  - 4. Schedule for routine cleaning and maintenance
  - 5. Repair instructions
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
  - 1. Include procedures to follow and required notifications for warranty claims.
  - 2. Contact data for all equipment and warranty issues - post in view on all equipment.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUAL

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in the manual identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.
- C. Manufacturers' Maintenance Documentation. Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard printed maintenance instructions and bulletins
  - 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly
  - 3. Identification and nomenclature of parts and components
  - 4. List of items recommended to be stocked as spare parts
- D. Maintenance Procedures. Include the following information and items that detail essential maintenance procedures:
  - 1. Test and inspection instructions
  - 2. Troubleshooting guide
  - 3. Precautions against improper maintenance
  - 4. Disassembly; component removal, repair, and replacement; and reassembly instructions
  - 5. Aligning, adjusting, and checking instructions
  - 6. Demonstration and training videotape, if available
- E. Maintenance and Service Schedules. Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
  - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
  - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.

- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent - post in view of/on all equipment.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
- I. Include procedures to follow and required notifications for warranty claims.

## **PART 3 EXECUTION**

### **3.1 MANUAL PREPARATION**

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to emergency, operation, and maintenance manuals.
- B. Emergency Manual: Assemble complete set of emergency information indicating procedures for use by emergency personnel and Owner's operating personnel for types of emergencies indicated.
- C. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- D. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.
  - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
  - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.
- E. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
  - 1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- F. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
  - 1. Do not use original Project Record Documents as part of operation and maintenance manuals.
  - 2. Comply with requirements of newly prepared Record Drawings in Division 01, Section "Project Record Documents."
- G. with Division 01, Section "Closeout Procedures" for the schedule for submitting operation and maintenance documentation.

END OF SECTION

**02 00 00**

**EXISTING CONDITIONS**

**PART 1 GENERAL**

1.1 RELATED SECTIONS

- A. 01 40 00 Quality Requirements
- B. 01 70 00 Execution and Closeout Requirements

1.2 SUMMARY

- A. Use of Survey provided in Project Documents.
- B. Construction Work on site.
- C. Unforeseen Conditions.
- D. Special considerations in existing spaces.

**PART 2 PRODUCTS** - Not applicable to this Section

**PART 3 EXECUTION**

3.1 EXISTING CONDITIONS REPRESENTED ON SITE SURVEY

- A. Existing site setbacks and easements shall be respected throughout construction, unless express written permission is given by the Owner to do otherwise.
  - 1. Omission of setbacks and easements from the Architectural and/or Civil Site Drawings does not absolve the Contractor from Following Setbacks indicated in the Survey.
- B. Work is to be completed entirely within an existing building. No survey is provided. Contractor shall be responsible for the field verification of all existing conditions in affected areas, prior to the performance of work in affected areas.
- C. Existing utilities, sewers, or other services on site that serve other structures or properties shall be protected during construction.
  - 1. Architect must be notified at once if utilities, sewers, or other services not appearing on the Survey are discovered on site.
  - 2. Architect must be notified at once if utilities, sewers, or other services conflict with proposed work.

3.2 EXISTING STRUCTURES AND FACILITIES ON SITE.

- A. Construction Operations: Do not damage building elements and improvements indicated to remain.
- B. Utilities: Locate, identify, disconnect, and seal or cap off utilities in buildings to be demolished.
- C. Occupied Structures and Adjacent Facilities: Do not close or obstruct streets, walks, drives or other occupied or used spaces or facilities without the written permission of the Owner and the authorities having jurisdiction. Do not interrupt utilities serving occupied or used facilities without the written permission of the Owner and authorities having jurisdiction. If

necessary, provide temporary utilities.

- D. Operations: Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.
- E. Security: Provide adequate protection against accidental trespassing. Secure project after work hours.
- F. Restoration: Restore sidewalks, driveways, landscape, and other site elements indicated to remain, if damaged by construction.

### 3.3 UNFORESEEN CONDITIONS

- A. Notify Architect at once of any unforeseen conditions on site that may affect the work.

### 3.4 SPECIAL CONSIDERATIONS IN EXISTING SPACES

- A. Contractor shall visually confirm structural integrity of existing walls, floors, and other structural members indicated to remain upon start of work.
- B. Contractor shall review and document the condition of interior items indicated to remain upon start of work. These items shall be protected as indicated in the drawings:
  - 1. Mechanical Equipment
  - 2. Electrical Equipment
  - 3. Light Fixtures
  - 4. Plumbing Equipment and Fixtures
  - 5. Conveyance Equipment
  - 6. Nonstructural Partitions
  - 7. Doors.
    - a. Documentation shall include assessment of proper functioning of hardware (including closers), and presence of round "knob" door handles.
  - 8. Windows
    - a. Documentation shall include assessment of proper functioning of operable windows (including security windows).
  - 9. Furnishings.
    - a. Where furnishings disrupt the progress of work, arrangements shall be made with the Owner for the proper storage of the furnishings.
  - 10. Other appurtenances and equipment present in the space and indicated to remain, including but not limited to systems furniture, residential and commercial kitchen equipment, shop equipment, office equipment, laundry equipment, lab and medical equipment, and other items found in the building.
    - a. Where appurtenances and equipment disrupt the progress of work, arrangements shall be made with the Owner for the proper storage of the appurtenances and equipment.
    - b. Plumbing and Mechanical connections to existing appurtenances and equipment shall be temporarily capped-off when appurtenances and equipment are disconnected.
    - c. Electrical circuits serving existing appurtenances and equipment shall be labeled at the breaker, and the breaker turned to 'off' position when appurtenances and equipment are disconnected.
- C. Upon start of work, Contractor shall review Mechanical, Electrical, and Plumbing equipment indicated to be removed and/or replaced, for verification of work done by other parties prior to this project.

END OF SECTION

**02 41 19**

**SELECTIVE DEMOLITION**

**PART 1 GENERAL**

1.1 SUMMARY

- A. Selective Site Demolition:
  - 1. Demolition of designated site improvements including paving, curbing, site walls, and utility structures.
  - 2. Demolition of below-grade foundations and site improvements to depth to avoid conflict with new construction or site work.
  - 3. Removal of hollow items or items which could collapse.
  - 4. Salvage of designated items.
  - 5. Protection of site work and adjacent structures.
  - 6. Disconnection, capping, and removal of utilities.
  - 7. Pollution control during building demolition, including noise control.
  - 8. Removal and legal disposal of materials.
  - 9. Designated site improvements and adjacent construction.
  - 10. Interruption, capping or removal of utilities as applicable.
  
- B. Selective Building Demolition:
  - 1. Selective demolition of interior partitions, systems, and building components designated to be removed.
  - 2. Selective demolition of exterior facade, structures, and components designated to be removed.
  - 3. Protection of portions of building adjacent to or affected by selective demolition.
  - 4. Removal of abandoned utilities and wiring systems.
  - 5. Notification to Owner of schedule of shut-off of utilities which serve occupied spaces.
  - 6. Pollution control during selective demolition, including noise control.
  - 7. Removal and legal disposal of materials.
  - 8. Protection of designated site improvements and adjacent construction.
  - 9. Salvage of designated items.
  - 10. Interruption, capping or removal of utilities as applicable.
  
- C. Hazardous Materials:
  - 1. Not present.
  - 2. Removed under separate prior contract.
  - 3. Removed as a part of this contract.

1.2 SUBMITTALS

- A. Submit under provisions of Section 01 30 00 - Administrative Requirements.
- B. Schedule: Submit for approval selective demolition schedule, including schedule and methods for capping utilities to be abandoned and maintaining existing utility service.

1.3 QUALITY ASSURANCE

- A. Codes and Regulations: Comply with governing codes and regulations. Use experienced workers.

1.4 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.5 SEQUENCING

- A. Immediate areas of work will not be occupied during selective demolition. The public, including children, may occupy adjacent areas.
- B. No responsibility for buildings and structures to be demolished will be assumed by the Owner.
- C. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

**PART 2 PRODUCTS** - Not applicable to this Section.

**PART 3 EXECUTION**

3.1 SELECTIVE DEMOLITION

- A. Demolition Operations: Do not damage building elements and improvements indicated to remain. Items of salvage value, not included on schedule of salvage items to be returned to Owner, shall be removed from structure. Storage or sale of items at project site is prohibited.
- B. Utilities: Locate, identify, disconnect, and seal or cap off utilities in buildings to be demolished.
- C. Shoring and Bracing: Provide and maintain interior and exterior shoring and bracing.
- D. Occupied Spaces: Do not close or obstruct streets, walks, drives or other occupied or used spaces or facilities without the written permission of the Owner and the authorities having jurisdiction. Do not interrupt utilities serving occupied or used facilities without the written permission of the Owner and authorities having jurisdiction. If necessary, provide temporary utilities.
- E. Operations: Cease operations if public safety or remaining structures are endangered. Perform temporary corrective measures until operations can be continued properly.
- F. Security: Provide adequate protection against accidental trespassing. Secure project after work hours.
- G. Restoration: Restore finishes of patched areas.

3.2 SCHEDULE

- A. Refer to Demolition and Construction Plans for:
  - 1. Items for Protection During Demolition and Construction: (The following are samples only)
  - 2. Items to be Salvaged for Reinstallation:
  - 3. Items to be Salvaged for Delivery to Owner:
  - 4. Utilities Requiring Interruption, Capping, or Removal:

END OF SECTION

**04 22 00**

**CONCRETE MASONRY UNITS**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes furnishing and installing unit masonry assemblies, including:
  - 1. Concrete masonry units, including masonry lintels, bond beams, flashings, and related work.
  - 2. Portland cement-lime mortar.
  - 3. Grouted reinforced masonry work as indicated.
  - 4. Cleaning masonry work.

1.3 RELATED WORK

- A. Related Work of Other Sections.
  - 1. Division 01 Section – Testing Laboratory Services.
  - 2. Division 03 Section – Cast-in-Place Concrete.
  - 3. Division 05 Section – Structural Steel: Shelf angles and structural supports built into masonry work.
  - 4. Division 05 Section – Metal Fabrications.
  - 5. Division 07 Section – Fluid-Applied Membrane Weather Barriers.
  - 6. Division 07 Section – Building Insulation.
  - 7. Division 07 Section – Joint Sealants.
  - 8. Division 08 Section – Steel Doors and Frames.
  - 9. Division 08 Section – Entrances and Storefront.
  - 10. Division 09 Section – Gypsum Board Systems: Exterior gypsum sheathing.

1.4 REFERENCES

- A. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM C90 – Standard Specification for Loadbearing Concrete Masonry Units.
- C. ASTM D 1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.

1.5 SUBMITTALS

- A. Prior to placing orders for Portland cement, provide certified test results showing compliance with requirements, including compliance with the low-alkali requirements.
- B. Submit product data for each type of concrete masonry unit and masonry work accessory.

1.6 QUALITY ASSURANCE

- A. Pre-Installation Conference: Prior to start of masonry work, meet at Project Site with installer ("Mason"), and representatives of other entities directly concerned with performance of masonry work including test agencies, governing authorities, product manufacturers, Architect, Construction Manager, and Owner.
  - 1. Review requirements (Contract Documents), submittals, status of coordinating work, availability of materials and installation facilities, proposed installation schedule, requirements for inspections and testing, forecasted weather conditions, and proposed installation procedures.
  - 2. Record discussion including agreement or disagreement on matters of significance; furnish copy of recorded discussions to each participant.
  - 3. Discuss masonry protection requirements for construction period extending beyond masonry completion.
  - 4. If meeting ends with substantial disagreements, determine how disagreement will be resolved and set date for reconvened meeting.

#### 1.7 DELIVERY, STORAGE AND HANDLING

- A. Store concrete masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location Do not use cementitious materials that have become damp.
- C. Store aggregates where grading can be maintained and contamination avoided.

#### 1.8 PROJECT CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
  - 1. Extend covers minimum 24" down both sides of wall and hold securely in place. Where one wythe of multi-wythe masonry is completed in advance of other wythes, secure cover a minimum 24" down face next to unconstructed wythe and hold cover in place.
  - 2. Stain Prevention: Prevent grout, mortar, and soil from staining masonry surfaces exposed to view or scheduled to be painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 3. Cold-Weather Protection Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace masonry damaged by frost or freezing conditions. Comply with cold weather construction requirements as prescribed by codes in force.
  - 4. Hot-Weather Protection Requirements: Protect unit masonry when temperature and humidity conditions produce excessive evaporation of water from mortar and grout. Provide artificial shade, wind breaks, and use cooled materials as required. When ambient temperature exceeds 100°F. (38°C.), or 90°F. (32°C.) with a wind greater than 8 mph (12.8-Km/hr), do not spread mortar bed greater than 48" ahead of masonry. Set masonry units within one minute of spreading mortar.

### PART 2 PRODUCTS

#### 2.1 MATERIALS

- A. Concrete Masonry Units:
  - 1. Lightweight Concrete Masonry Units (CMU-1): ASTM C 90, Lightweight, Type I,

moisture controlled units in sizes indicated. Conform to UL requirements at all fire-rated masonry construction. Provide sash block units at control joints and continuous control joint filler.

2. Special Shapes (CMU-04): Provide lintels, bullnose units for outside corners, jambs, control joints, window sill units, solid copings and other conditions indicated. Provide U-shaped lintel blocks with solid bottoms over window and door openings. Provide straight internal corners and straight units at all base locations.
- B. Mortar and Grout:
1. Low Alkali Portland Cement: ASTM C 150, low alkali type with not more than 0.60% water-soluble alkali. Provide Type I, except Type III may be used for setting masonry during cold weather. Subject to compliance with requirements, provide TXI Cement Company, New Braunfels, TX, (Tel) 512-396-4244, Type I low alkali Portland cement, or approved equivalent. Do not use masonry cement.
  2. Mortar Mix: Provide Portland cement-lime mortar complying with ASTM C 270, Type S mortar mix (1800 psi) for reinforced unit masonry work and Type N mortar mix (750 psi) for veneer masonry. Provide mortar mix consisting of low alkali Portland cement (ASTM C 150, Type I) as specified, lime (ASTM C 207, Type S), clean sand (ASTM C 144, with not less than 100% passing a No. 8 sieve), coloring and water for workable mix. Do not use masonry cement.
    - a. Mortar Color: Standard gray Portland cement-lime mortar to match approved sample.
- C. Accessories: Provide standard hot-dipped galvanized anchors and accessories for exterior locations and mill galvanized anchors and accessories at interior locations.
1. Anchors:
    - a. Types as recommended by masonry manufacturer.
  2. Concealed Masonry Flashing: "C-Coat Flashing" by Hohmann & Barnard, Inc., or equivalent by AFCO Products, Polytite Manufacturing Corp., Sandell Manufacturing Co., or York Manufacturing, Inc.
  3. Masonry Flashing Drip-Edge: Hohmann & Barnard FTSA Drip Plate, or equivalent.
  4. Reinforcing Bars:
    - a. Types as recommended by masonry manufacturer.
  5. Compressible Filler: Hohmann & Barnard "No. NS," 3/8" thick, or equivalent by Dur-O-Wal.
  6. Bond Breakers: Asphalt saturated organic felt, ASTM D 226, Type I, No. 15.
  7. Masonry Cleaners: ProSoCo, Inc., Kansas City, MO, "Sure Klean 600" general purpose detergent cleaner, "Sure Klean 101 Lime Solvent" for removal of excess mortar and job stains, and "White Scum Remover" for removal of insoluble salt scums from mortar, or equivalent cleaners formulated to be safe on masonry and non-masonry surfaces such as anodized aluminum, painted surfaces and similar finishes.
  8. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard; Mortar Net USA, Ltd.; Mortar Net Weep Vents.
  9. Drill Screw Fasteners for Screw Attached Masonry Veneer Anchors and Ties: ASTM C 954, except with hex washer head and neoprene washer, No. 10 by length require to penetrate steel stud flange by not less than three exposed threads, and with organic polymer coating complying with ASTM B 117; "Traxx" by ITW-Buildex or "Dril-Flex" by Elco Industries.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine conditions, with installer present, for compliance with requirements for installation

tolerances and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 LAYOUT OF MASONRY WORK

- A. Layout walls in advance for accurate spacing of surface bond patterns, to provide uniform joint widths and to properly locate openings, movement-type joints, returns and offsets. Avoid the use of less-than-half size units at corner, jambs, and wherever possible at other locations.
- B. Notify architect of any opening locations that conflict with Concrete Masonry Unit coursing, in either horizontal or vertical dimensions.

### 3.3 MASONRY INSTALLATION

- A. Lay-up exterior concrete masonry unit work in bond indicated in exterior elevations.
- B. Laying Masonry General:
  - 1. Lay concrete masonry units making sure head joints and bed joints are full of mortar.
  - 2. Lay concrete masonry units plumb and true to line.
  - 3. Where fresh mortar joins partially set mortar, remove loose concrete masonry unit and mortar and lightly wet the exposed surface of set masonry.
  - 4. When adjustment must be made after mortar begins to harden, remove hardened mortar and replace it with fresh mortar.
  - 5. Remove excess mortar as Work progresses.
- C. Masonry Reinforcing and Anchors: Install as indicated and in accordance with the reinforcing manufacturer's requirements.
- D. Fabricated Steel Lintels: Install as indicated in Structural Drawings.
- E. Control And Expansion Joints:
  - 1. Install control and expansion joints as indicated on Drawings.
  - 2. Keep joints free of mortar and any debris that may hinder movement.
  - 3. Install expansion joint material and finish the joint with a sealer.
- F. Cleanouts for Grouting: Provide clean-outs in cells to be grouted at maximum 5- foot centers, vertically. Remove excess mortar by "rodding" and with compressed air. After cleaning cells to be grouted, close clean-outs with masonry to match adjacent construction. Do not place grout until entire height of masonry has attained sufficient strength to resist grout pressure. Place grout in such a way as to prevent segregation of materials. Pour grout fluid enough to flow into all crevices of grout spaces leaving no voids.
  - 1. Cutting and Patching: Provide full size units matching existing adjacent construction for size, texture, bond, and joint profile. Perform repairs so that repaired area is relatively imperceptible in the completed Work.
- G. Laying Masonry: Lay masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove in place. Do not slush head joints.
- H. Stopping and Resuming Work: In each course, rack back 1/2 unit length for running bond or 1/3 unit length for one-third running bond; do not tooth except at repairs in existing construction. Clean exposed surfaces of set masonry, wet clay masonry units lightly (if required), and remove loose masonry units and mortar prior to laying fresh masonry.
- I. Correction of Damaged Masonry: Remove and replace masonry units that are loose, chipped, broken, stained or otherwise damaged, or if units do not match adjoining units as

required. Provide new units to match adjoining units and install fresh mortar or grout, pointed to eliminate evidence of replacement.

### 3.4 CLEANING AND PROTECTION

- A. Cleaning Concrete Masonry Units: Clean exposed concrete masonry units by dry brushing at the end of each days work and after final pointing to remove mortar spots and droppings. Comply with NCMA Bulletin No. 28.
- B. Protection of Masonry Work: Protect partially completed masonry against weather at the end of each day's work and when work is not in progress, by covering top of walls with strong, waterproof, non-staining membrane. Extend membrane at least 24" down both sides of walls and hold cover securely in place. Protect bases of walls from mud, mortar and other stains. Where cutting, forming, welding and similar operations must be performed near or above masonry work, provide substantial protection against damage.

### 3.5 FIELD QUALITY CONTROL

- A. Test and evaluate each 5,000 sq. ft. or grouted reinforced masonry work, or fraction thereof, as follows:
  - 1. Mortar Compressive Strength: Provide sampling and testing in accordance with ASTM C 780.
  - 2. Grout Compressive Strength: Provide sampling and testing in accordance with ASTM C 1019.
- B. Evaluation of Quality Control Tests: In the absence of other indications of noncompliance, masonry will be considered satisfactory if results from construction quality control tests comply with minimum requirements indicated.

END OF SECTION

**06 10 00**

**ROUGH CARPENTRY AND PLYWOOD**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes furnishing and installing:
  - 1. Dimension Lumber
  - 2. Wood furring, grounds, nailers and blocking.
  - 3. Plywood wall sheathing at areas indicated.

1.3 RELATED WORK

- A. Related Work of Other Sections:
  - 1. Section 03 30 00 – Cast-In-Place Concrete.
  - 2. Section 05 50 00 – Metal Fabrications.
  - 3. Section 06 20 00 – Finish Carpentry.
  - 4. Section 07 27 26 – Fluid-Applied Membrane Weather Barriers.
  - 5. Section 07 52 16 – SBS Modified Bitumen Membrane Roofing.
  - 6. Section 07 60 00 – Flashing and Sheet Metal.
  - 7. Section 09 21 16 – Gypsum Board Assemblies for weather resistant gypsum sheathing at all locations other than where plywood wall sheathing is noted.
  - 8. Section 10 28 13 – Toilet Accessories.

1.4 DESIGN/PERFORMANCE REQUIREMENTS

- A. Structural Performance
  - 1. Design Wind Load: Refer to Structural General Notes.
  - 2. Roof Loads: Design, fabricate and install roof framing to resist a uniform roof live load of 20-psf and 20-psf dead load.
  - 3. Deflection Limits: Design truss system to withstand design wind, dead and live loads without deflection greater than the following:
    - a. Roof Framing: Vertical deflection of L/240 of the clear span or 3/4," whichever is less.

1.5 SUBMITTALS

- A. Product Data: Submit product data for engineered wood products, underlayment, insulating sheathing, air infiltration barrier, and construction adhesives. Submit product data for each size of metal framing anchors and hurricane anchors indicating load capacity.
  - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that materials comply with requirements.

1.6 QUALITY ASSURANCE

- A. Wood Structural Design Standard: Comply with applicable requirements in AFPA's "National Design Specifications for Wood Construction" and its "Supplement."

#### 1.7 ENVIRONMENTAL PERFORMANCE REQUIREMENTS:

- A. Provide structural sheathing and underlayment manufactured without a formaldehydebased binding resin or that has a formaldehyde emission below 0.05 ppm.
- B. Do not use woods listed by CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora), [www.cites.org](http://www.cites.org).
- C. Preservative treatments shall be waterborne, free of arsenic and chromium.

#### 1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Keep materials under cover and dry. Protect against exposure to weather and contact with damp or wet surfaces.
- B. Stack lumber as well as plywood and other panels; provide for air circulation within and around stacks and under temporary coverings including polyethylene and similar materials.

### PART 2 PRODUCTS

#### 2.1 DIMENSION LUMBER

- A. Provide lumber manufactured to comply with DOC PS 20 "American Softwood Lumber Standard" and with applicable grading rules of inspection agencies certified by American Lumber Standards Committee's (ALSC) Board of Review. Provide dressed lumber, S4S, air seasoned with maximum 19 percent maximum moisture content, "SDRY," 2-inch or less in nominal thickness. Provide graded and grade-marked lumber as follows, complying with the association grading rules, under whose rules the material was produced. In the event Contractor wishes to use lumber of other species or grades, submit pertinent data for Architect's approval prior to placing orders.
  - 1. Blocking, Furring, Rough Lumber, Joists, Rafters, Headers Beams and Other Horizontal Framing, Not Otherwise Specified: Douglas Fir - Larch No. 2 (WWPA) or Southern Pine No. 2 (SPIB). Preservative treat all plates and other lumber in contact with concrete and roof fascia's.
  - 2. Preservative treat as specified roof curbs and cants; all nailers, blocking, and plates in contact with concrete or masonry; roof edges; wood framing members less than 18" above grade, structural support for decks; and other items indicated.

#### 2.2 CONSTRUCTION PANELS

- A. Provide plywood panels complying with DOC PS1 "US Product Standard for Construction and Industrial Plywood" and mat formed or composite panels complying with DOC PS2 "Performance Standards for Wood-based Structural-Use Panels." Factory-mark each panel with APA trademark indicating compliance with grade requirements. Provide the following:
  - 1. Plywood Wall Sheathing: APA RATED SHEATHING, EXTERIOR or EXPOSURE 1, 32/16, minimum 1/2" thick, veneer plywood only.
    - a. Corrosion-Resistant Insulation Fasteners and Plates for Use with Steel Roof Decks: Provide Johns-Manville, Inc. "UltraFast" hex washer head fasteners with a modified buttress thread form, "X" point tip and blue "ClimaSeal Premium Coating" exceeding the corrosion resistance of FM #4470 for Class 1A Insulated Steel Deck Construction, including I-90 Windstorm Resistance, or equivalent recommended by roof manufacturer in writing. Provide No. 12 fasteners size x length required to penetrate deck by at least 3/4-inch.

2. Exposed Plywood for Equipment Mounting: Exterior type, APA A-C, EXTERIOR, thickness indicated.

### 2.3 PRESERVATIVE TREATMENT

- A. Comply with applicable requirements of AWPA C2 (Lumber) and AWPA C9 (plywood). Provide treatment after members are shaped with waterborne micronized copper quaternary (MCQ), ammonical copper quat-B (ACQ-B), alkaline copper quat-D (ACQD), or copper azole (CA-B) preservative by vacuum pressure full-cell process in accordance with AWPA Standard Specification P-5 and as follows:
  1. Above Ground Use Waterborne Dry Salt Retention: 0.25 lb./cu. ft.
  2. Kiln dry members after treatment to 15% MC. Mark each treated item with the Quality Mark Requirements of an inspection agency approved by ALSC's Board of Review.
  3. Re-grade and re-stamp lumber after kiln drying in accordance with lumber producer's grading rules.

### 2.4 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, use materials complying with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
  1. Use treatment that does not promote corrosion of metal fasteners.
  2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
- C. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Kiln-dry plywood after treatment to a maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
- E. Application: Treat items indicated on Drawings, and the following:
  1. Framing for raised platforms.
  2. Framing for stages.
  3. Concealed blocking.
  4. Plywood backing panels.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Set rough carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.
  1. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required by the Nailing Schedule requirements of local codes of authorities having jurisdiction.
  2. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not penetrate members where opposite side will be exposed or covered with finish

- materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drilled wood members as required.
3. Do not use materials with defects that might impair quality of rough carpentry or pieces that are too small to use with minimum joints or optimum joint arrangement.
  4. Except as otherwise specified, use hot-dip galvanized nails for all exterior work.
- B. Plywood: Follow applicable recommendations contained in Form No. E30L, "APA Design/Construction Guide-Residential & Commercial," for plywood product types and applications shown.
1. Wall Sheathing: Provide 1/8" space between long edges of panels and 1/8" space between panel ends. Nail 6" o.c. maximum along panel edges and 12" o.c. maximum along intermediate supports with 10d common nails. For panels subject to high wind loads, nail 4" o.c. along all panel edges and 6" o.c. along intermediate framing with 10d common nails or 8d ring shank nails. Extend sheathing to the lowest point of plate.
  2. Roof Sheathing/Insulation: Provide 1/8" space between long edges of panels and 1/8" space between panel ends. Screw fasten 6" o.c. maximum along panel edges and 12" o.c. maximum along intermediate supports with self-drilling corrosion-resistant sheet metal screws to metal roof deck to comply with roof deck performance requirements. For panels subject to high wind loads, screw fasten 4" o.c. along all panel edges and 6" o.c. along intermediate framing with with corrosion-resistant self-drilling sheet metal screws through load dissipating washers. Install two layers of nail base roof insulation with long dimension perpendicular to roof deck and with all joints staggered at least 24-inches from layer below.
  3. Use full sheets of sheathing to the greatest extent possible; do not use scraps to fill in areas.
  4. Extend wall sheathing to the lowest point of wood framing top and bottom.
  5. Provide 1/8" space between long edges of panels and 1/8" space between panel ends. Locate wall sheathing panel long dimension edges over support framing members. Stagger wall and roof sheathing panel end joints from course to course at least 16."
- C. Cover sheathing with fluid-applied membrane weather barrier, shingle lapped, and nailed with galvanized roofing nails. Tape all joints and laps with sheathing tape. Repair deteriorated or damaged fluid-applied membrane weather barrier conforming to specified requirements.

END OF SECTION

**06 20 00**

**FINISH CARPENTRY**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
  - 1. Interior standing and running trim.
  - 2. Interior fixed and adjustable closet and storage shelving.
- B. Related Requirements:
  - 1. Section 06 10 00 "Rough Carpentry" for furring, blocking, and other carpentry work not exposed to view].
  - 2. Section 06 40 00 "Architectural Woodwork" for shop fabricated wood cabinets and wood paneling.
  - 3. Section 07 92 00 "Joint Sealants."
  - 4. Section 09 90 00 "Painting and Coating."

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials, dimensions, profiles, textures, and colors and include construction and application details.
- B. Samples for Initial Selection: For each type of product involving selection of colors, profiles, wood species, and cut, and.
- C. Interior Standing and Running Trim Samples: 2'-0" long x full board or molding width, unfinished.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Stack lumber, plywood, and other panels flat with spacers between each bundle to provide air circulation. Protect materials from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.
- B. Deliver interior finish carpentry only when environmental conditions meet requirements specified for installation areas. If finish carpentry must be stored in other than installation areas, store only where environmental conditions meet requirements specified for installation areas.

**PART 2 PRODUCTS**

2.1 MATERIALS, GENERAL

- A. Lumber: DOC PS 20 and applicable grading rules of inspection agencies certified by the

American Lumber Standards' Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.
  2. For exposed lumber, mark grade stamp on end or back of each piece, or omit grade stamp and provide certificates of grade compliance issued by inspection agency.
- B. Softwood Plywood: DOC PS 1.
- C. Hardboard: AHA A135.4
- D. Glue: Provide aliphatic or phenolic-resin wood glue recommended for general carpentry use.

## 2.2 FINISH CARPENTRY

- A. WM/Series Wood Molding Patterns: For stock molding patterns graded under Wood Molding and Millwork Producers Industry Standard WM 4, provide P-Grade for painted finish and N-Grade for transparent finish, fabricated from any Western softwood species graded and inspected by WWPA.
1. Wood Base (Basis of Design): BMC Wedge Baseboard BW2-FJ, 7/16-inch x 3-1/4-inch finger-jointed paint grade pine.
- B. Standing and Running Trim for Painted Finish: Any Western softwood species graded and inspected by WWPA complying with following requirements:
1. Grade for Standard Sizes and Patterns: "C Select" or "Choice" for Idaho White Pine.
  2. Grade for Special (Custom) Sizes and Patterns: AWI "Custom Grade" for quality of materials and manufacture.

## 2.3 MISCELLANEOUS MATERIALS

- A. Adhesives: Provide type of adhesives recommended by AWI to suit specified application.
- B. Fasteners: Provide nails, screws, and other anchoring devices of type, size, material and finish required for application indicated to provide secure attachment, concealed where possible and complying with applicable Federal Specifications. Provide hot-dip galvanized finish (ASTM A 153) on all fasteners exposed to exterior and high relative humidity.
- C. Joint Sealants: Refer to Section 07 90 00 for requirements.

## 2.4 FABRICATION

- A. Back out or kerf backs of standing and running trim wider than 5 inches, except members with ends exposed in finished work.
- B. Ease edges of lumber less than 1 inch in nominal thickness to 1/16-inch radius and edges of lumber 1 inch or more in nominal thickness to 1/8-inch radius.

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine finish carpentry materials before installation. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Clean substrates of projections and substances detrimental to application.
- B. Prime lumber and moldings to be painted, including both faces and edges, unless factory primed. Cut to required lengths and prime ends. Comply with requirements in Section 09 Section "Painting and Coating."

### 3.3 INSTALLATION, GENERAL

- A. Do not use materials that are unsound, warped, improperly treated or finished, inadequately seasoned, or too small to fabricate with proper jointing arrangements.
  - 1. Do not use manufactured units with defective surfaces, sizes, or patterns.
- B. Install finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.
  - 1. Scribe and cut finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
  - 2. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
  - 3. Coordinate finish carpentry with materials and systems in or adjacent to it. Provide cutouts for mechanical and electrical items that penetrate finish carpentry.

### 3.4 ADJUSTING

- A. Replace finish carpentry that is damaged or does not comply with requirements. Adjust joinery for uniform appearance.

### 3.5 CLEANING

- A. Clean finish carpentry on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

### 3.6 PROTECTION

- A. Protect installed products from damage from weather and other causes during construction.
- B. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
  - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

**08 11 00**

**HOLLOW METAL DOORS AND FRAMES**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes furnishing and installing:
1. Hollow metal doors.
  2. Hollow metal frames.
  3. Sidelight frames
  4. Fire-rated door and frame assemblies.
  5. Vision lite frame trim in doors.

1.3 RELATED WORK

- A. Related Work of Other Sections:
1. Division 04 Section – Unit Masonry
  2. Division 04 Section – Exterior Stone Cladding
  3. Division 07 Section – Joint Sealants.
  4. Division 08 Section – Wood Doors.
  5. Division 08 Section – Entrances and Storefront
  6. Division 08 Section – Door Hardware.
  7. Division 09 Section – Gypsum Board Assemblies.
  8. Division 09 Section – Painting and Coating.
  9. Division 13 Section – Metal Building Systems.

1.4 SUBMITTALS

- A. Product Data: For each type of door and frame indicated, include door designation, type, level and model, material description, core description, construction details, label compliance, sound and fire-resistance ratings, and finishes.
- B. Shop Drawings: Show the following:
1. Elevations of each door design.
  2. Details of doors including vertical and horizontal edge details.
  3. Frame details for each frame type including dimensioned profiles.
  4. Details and locations of reinforcement and preparations for hardware.
  5. Details of each different wall opening condition.
  6. Details of anchorages, accessories, joints, and connections.
  7. Coordination of glazing frames and stops with glass and glazing requirements.
- C. Door Schedule: Use same reference designations indicated on Drawings in preparing schedule for doors and frames.

1.5 QUALITY ASSURANCE

- A. Steel Door and Frame Standard: Comply with ANSI A 250.8, unless more stringent requirements are indicated.
- B. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.
  - 1. Test Pressure: Test at positive pressure in accordance with UBC Standard 7-2.
  - 2. Oversize Fire-Rated Door Assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to authorities having jurisdiction that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
  - 3. Temperature-Rise Rating: Where indicated, provide doors that have a temperature-rise rating of 450 deg F maximum in 30 minutes of fire exposure.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Inspect doors and frames on delivery for damage, and notify shipper and supplier if damage is found. Minor damages may be repaired provided refinished items match new work and are acceptable to Architect. Remove and replace damaged items that cannot be repaired as directed.
- C. Store doors and frames at building site under cover. Place units on minimum 4-inch- high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber. If door packaging becomes wet, remove cartons immediately. Provide minimum 1/4-inch spaces between stacked doors to permit air circulation.

#### 1.7 SEQUENCING AND SCHEDULING

- A. Submit data and schedule at earliest possible date, particularly where acceptance of schedule must precede fabrication of units that must be built into other work. Coordinate door and frame work with door hardware specified in Division 08 Section – Door Hardware.

### **PART 2 PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with Project requirements, provide hollow metal door and frame units produced by one of the following:
  - 1. Amweld Building Products, Inc. (330) 527-4385.
  - 2. Curries Co. (515) 423-1334.
  - 3. Deansteel Manufacturing Co. (210) 226-8271
  - 4. The Kewanee Corp. (800) 666-4481.
  - 5. Mesker Door Co. (205) 851-6670.
  - 6. Premier Products, Inc. (318) 361-0796.
  - 7. Republic Builders Products (901) 352-3383.

#### 2.2 MATERIALS

- A. Steel Sheet, General: Thickness dimensions, including those referenced in ANSI A250.8, are minimums as defined in referenced ASTM standards for both uncoated steel sheet and the uncoated base metal of metallic-coated steel sheets.

- B. Hot-Rolled Steel Sheets: ASTM A 569, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Cold-Rolled Steel Sheets: ASTM A 366, Commercial Steel (CS), or ASTM A 620, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.
- D. Anchors and Accessories: Manufacturer's standard units suitable for type of wall construction, and as follows.
  - 1. Provide square profile stops with mitered corners for glazing and louvers.
  - 2. Use galvanized items for units built into exterior walls.
  - 3. Provide countersunk flat or small oval head Philips or Jackson head fasteners where exposed to view.
- E. Primer: Manufacturer's standard rust-inhibitive primer, suitable as a base for specified finish paints.

### 2.3 DOORS AND FRAMES

- A. General: Provide doors of sizes, thicknesses, and designs indicated.
- B. Provide the following doors and frames complying with ANSI/SDI A250.8 "Recommended Specifications for Standard Steel Doors and Frames," and as specified.
  - 1. Exterior Doors: Level 3 and Physical Performance Level A for Extra Heavy Duty, Model 2 doors, "Seamless Design," fabricated with minimum 0.053" thick (old 16 gage) hot-dip galvanized steel faces and edges, insulated "Steel Stiffened Core," with top and bottom flush end closures sealed to eliminate moisture entry into door, and with closer reinforcement.
  - 2. Interior Doors: Level 2 and Physical Performance Level B for Heavy Duty, Model 2 doors, "Seamless Design" fabricated from minimum 0.042" thick (old 18 gage) steel faces, with "Steel Stiffened Core" and with closer reinforcement.
  - 3. Exterior Frames: Level 3 and Physical Performance Level A for Extra Heavy Duty frames, fabricated from minimum 0.053" thick (old 16 gage) hot-dip galvanized steel with mitered and continuously seam welded (including rabbets and stop) corners, and with temporary spreader bar at bottom.
  - 4. Interior Frames: Level 2 and Physical Performance Level B for Heavy Duty frames, fabricated from minimum 0.042" thick (old 18 gage) steel sheet with mitered and continuously seam welded (including rabbets and stop) corners, and with temporary spreader bar at bottom.

### 2.4 FABRICATION

- A. General: Fabricate hollow metal door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.
- B. Exterior Door Construction: For exterior locations and elsewhere as indicated, fabricate doors, panels, and frames from metallic-coated steel sheet. Close top and bottom edges of doors flush as an integral part of door construction or by addition of 0.053- inch- thick (old 16 gage), metallic-coated steel channels with channel webs placed even with top and bottom edges.
- C. Interior Door and Panel Faces: Fabricate exposed faces of doors and panels, including stiles and rails of non-flush units, from the following material:
  - 1. Cold-rolled steel sheet.

- D. Core Construction: Manufacturer's standard core construction of the type specified that produces a door complying with SDI standards.
- E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch at jambs and heads, except not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.
- F. Clearances for Fire-Rated Doors: As required by NFPA 80.
- G. Single Acting, Door-Edge Profile: Square edge, unless beveled edge is indicated.
- H. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- I. Fabricate concealed stiffeners, reinforcement, edge channels, louvers, and moldings from either cold- or hot-rolled steel sheet.
- J. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat or oval heads for exposed screws and bolts.
- K. Hardware Preparation: Prepare doors and frames to receive mortised and concealed hardware according to final door hardware schedule and templates provided by hardware supplier. Comply with applicable requirements in ANSI A250.6 and ANSI A115 Series specifications for door and frame preparation for hardware.
  - 1. For concealed overhead door closers, provide space, cutouts, reinforcement, and provisions for fastening in top rail of doors or head of frames, as applicable.
- L. Frame Construction: Fabricate frames to shape shown.
  - 1. For exterior applications, fabricate frames with mitered or coped and continuously welded corners, rabbets, stops, and seamless face joints.
  - 2. For interior applications, fabricate frames with mitered or coped and continuously welded corners, rabbets, stops, and seamless face joints.
  - 3. Provide fully welded frames with temporary spreader bars. No open seams are acceptable.
  - 4. Electrical Knock Out Boxes: Factory weld 18 gauge electrical knock out boxes to frame for electrical hardware preps; included but not limited to electric thru wire hinges, electrical raceways, door position switches, electric strikes, jamb mount card readers, and magnetic locks as noted in door hardware sets in Division 8 Door Hardware.
    - a. Electrical knock out boxes are required at door position switches, electric strikes, card readers, and middle hinge locations for all exterior locations regardless of electrical hardware specified in Division 8 Door Hardware.
    - b. Provide electrical knock out boxes with 3/4-inch knockouts.
    - c. Conduit to be coordinated and installed in field from middle hinge box and strike box to door position box.
    - d. Electrical knock out boxes to comply with NFPA requirements and fit electrical door hardware as specified in hardware sets in Division 8 Door Hardware.
    - e. Electrical knock out boxes for continuous hinges should be located in the center of the vertical dimension on the hinge jamb.
    - f. Provide field installed conduit per Division 28 section for standardized plug connectors to accommodate up to twelve (12) wires as required for electrified door hardware specified in hardware sets in Division 8 Door Hardware. Provide sufficient number of concealed wires to accommodate electric function of specified hardware. Wire nut connections are not acceptable.
- M. Reinforce doors and frames to receive surface-applied hardware. Drilling and tapping for

surface-applied hardware may be done at Project site.

- N. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
- O. Glazing Stops: Manufacturer's standard, formed from 0.032-inch- thick steel sheet.
  - 1. Provide non-removable stops on outside of exterior doors and on secure side of interior doors for glass, louvers, and other panels in doors.
  - 2. Provide screw-applied, removable, glazing stops on inside of glass, louvers, and other panels in doors.
- P. Astragals: As required by NFPA 80 to provide fire ratings indicated.

## 2.5 FINISHES

- A. Prime Finish: Manufacturer's standard, factory-applied coat of rust-inhibiting primer complying with ANSI A250.10 for acceptance criteria.

## PART 3 EXECUTION

### 3.1 INSTALLATION

- A. General: Install hollow metal doors, frames, and accessories according to Shop Drawings, manufacturer's data, and as specified.
- B. Placing Frames: Comply with provisions in SDI 105, unless otherwise indicated. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is completed, remove temporary braces and spreaders, leaving surfaces smooth and undamaged.
  - 1. Except for frames located in existing walls or partitions, place frames before construction of enclosing walls and ceilings.
  - 2. In concrete construction, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Acceptable anchors include masonry wire anchors and masonry T-shaped anchors.
  - 3. In metal-stud partitions, provide at least three wall anchors per jamb; install adjacent to hinge location on hinge jamb and at corresponding heights on strike jamb. Attach wall anchors to studs with screws.
  - 4. Install fire-rated frames according to NFPA 80.
  - 5. For openings 90 inches or more in height, install an additional anchor at hinge and strike jambs.
  - 6. Seal open seams in exterior units to whatever extent not completed at the factory prior to painting.
- C. Door Installation: Comply with ANSI A250.8. Fit hollow-metal doors accurately in frames, within clearances specified in ANSI A250.8. Shim as necessary to comply with SDI 122 and ANSI/DHI A115.1G.
  - 1. Fire-Rated Doors: Install within clearances specified in NFPA 80.
  - 2. Smoke-Control Doors: Install to comply with NFPA 105.

### 3.2 ADJUSTING AND CLEANING

- A. Cleanup: Remove excess weld splatter by grinding flush with adjacent surfaces, without grinding skips or gouging parent metal. Refer to Section 09 90 00 - Paints and Coatings for surface preparation, primer and field applied finish coats.
- B. Prime-Coat Touchup: Immediately after installation, sand smooth any rusted or damaged

areas of prime coat and apply touch up of compatible air-drying primer.

- C. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

**09 20 00**

**GYPSUM BOARD AND LIGHT GAGE METAL FRAMING**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes furnishing and installing:
  - 1. Light Gage Metal Framing (Screw type steel board framing), framing for furring, and drywall ceiling suspension systems.
  - 2. Gypsum drywall board, weather resistant gypsum sheathing board, abuse resistant gypsum board, and cementitious backing units.
  - 3. Cementitious Backer Board.
  - 4. Gypsum board accessories.
  - 5. Gypsum board finishing.

1.3 RELATED WORK

- A. Related Work of Other Sections:
  - 1. Division 03 Section – Cast-In-Place Concrete.
  - 2. Division 04 Section – Unit Masonry.
  - 3. Division 05 Section – Cold-Formed Metal Framing.
  - 4. Division 05 Section – Metal Fabrications.
  - 5. Division 06 Section – Rough Carpentry for exterior plywood sheathing at mineral fiber cement siding.
  - 6. Division 07 Section – Fluid-Applied Membrane Weather Barriers.
  - 7. Division 07 Section – Joint Sealants.
  - 8. Division 07 Section – Sound Batt Insulation
  - 9. Division 08 Section – Hollow Metal Doors and Frames.
  - 10. Division 08 Section – Entrances and Storefront.
  - 11. Division 09 Section – Painting and Coating.

1.4 SUBMITTALS

- A. Product Data: Submit product data for each board material and accessory required, including specifications showing compliance with requirements.
- B. Samples: For the following products:
  - 1. Trim Accessories: Full-size Sample in 12-inch-long length for each trim accessory indicated.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to

authorities having jurisdiction.

- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.
- C. References and Industry Standard Guidelines:
  - 1. Association Publications
    - a. American Society for Testing and Materials (ASTM) International.
      - 1) ASTM C 754: Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products. West Conshohocken, PA: ASTM, 2000.
      - 2) C 473, Test Methods for Physical Testing of Gypsum Panel Products.
      - 3) C 1325, Specification for Fiber-Mat Reinforced Non-Asbestos Cement Interior Substrate Sheets.
      - 4) C 1002, Specification for Steel Drill screws for the Application of Gypsum Panel Products or Metal Plaster Bases.
    - b. American National Standards Institute (ANSI):
      - 1) A108.11, American National Standard for Interior Installation of Cementitious Backer Units.
      - 2) A118.1, American National Standard Specifications for Dry-Set Portland Cement Mortar.
      - 3) A118.4, American National Standard Specifications for Latex-Portland Cement Mortar.
      - 4) A118.9, Test Methods and Specifications for Cementitious Backer Units.
      - 5) A136.1, American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile.
  - 2. National Gypsum Company. Gypsum Construction Guide. 7th ed. Charlotte, NC: National Gypsum Company, 2001.
  - 3. USG Corporation. The Gypsum Construction Handbook. Centennial ed. Chicago, IL: USG Corporation, 2000.
  - 4. Gypsum Association Fire Resistance Design Manual GA-600.

## 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

## 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

## PART 2 PRODUCTS

### 2.1 PRODUCTS AND MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:
  - 1. Metal Support Materials;
    - a. Dale Industries, Inc., Dearborn, MI, (Tel) 313-846-9400.
    - b. Dietrich Industries, Inc., Hutchins, TX., (Tel) 214-225-1100.

- c. Gold Bond Building Products Div., National Gypsum Co., Charlotte, NC, (Tel) 704-365-0950.
- d. Amico/Maverick Steel Corp., Ennis, TX, (Tel) 800-528-5344.
- e. Unimast, Inc., Mansfield, TX, (Tel) 817-473 9346.
- 2. Gypsum Board and Related Products:
  - a. G-P Gypsum Products, Decatur, GA, (Tel) 404-987-5190.
  - b. Gold Bond Building Products Div., National Gypsum Co., Charlotte, NC, (Tel) 704-365-0950.
  - c. United States Gypsum Co., Chicago, IL, (Tel) 312-321-4000.
- 3. Direct Suspension Systems:
  - a. Armstrong World Industries, Houston, TX, (Tel) 800-448-1405.
  - b. Chicago Metallic Corp., Chicago, IL, (Tel) 312-563-4600.
  - c. National Rolling Mills, Paoli, PA, (Tel) 215-644-6700.
  - d. United States Gypsum Co., Chicago, IL, (Tel) 312-321-4000.

## 2.2 FRAMING AND SUPPORT SYSTEMS

- A. Light Gage Metal Framing: (Screw Type Steel Studs and Runners) ASTM C 645, fabricated from minimum 0.0179- inch thick zinc coated steel in sizes indicated, except provide minimum 0.0296-inch thick for studs used over limiting height or when required to support wall hung heavy loads. Provide 1-1/2" x 1-1/2" angle runner at perimeter of ceiling suspension panels for support of board panel edge and extruded aluminum ceiling panel edge closure trim.
- B. Non-Fire Rated Furring Bar Suspension System for Gypsum Board Ceilings: Armstrong 7900 Board Furring System with 7945 cross tees, HD 7801 wall angle, and 8887 board furring shoe, or equivalent by Chicago Metallic, or USG. Provide galvanized steel wire hangers, ASTM A 641, soft temper, sized so that stress at 3x hanger load (ASTM C 635, Table 1, Direct Hung) is less than wire yield stress. Size hanger anchorage devices for 3x calculated hanger load, except size direct pull-out concrete inserts for 5x calculated hanger load as determined by testing (ASTM E 488) conducted by a qualified independent testing agency. Coordinate with Division 09 Section - Acoustical Ceilings.
- C. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

## 2.3 BOARD MATERIALS

- A. Gypsum Board: ASTM C 36, 5/8" thick, unless otherwise shown.
  - 1. Fire rated (ASTM C 36, Type X requirements) where required for construction shown.
  - 2. Base Layer: Gypsum board, ASTM C 442 or gypsum board, ASTM C 36.
  - 3. Weather Resistant Gypsum Sheathing: Provide 1/2-inch thick, V-type T & G long edges and square butt ends, and with fiberglass reinforced faces for improved strength and weather resistance for up to 6 months of exposure; USG "Weatherock Exterior Sheathing" or Georgia-Pacific "Dens-Glass Gold."
    - a. Sheathing Tape: Carlisle Hardcast "VaporGrip-22" joint seam, flashing and vapor barrier sealing tape with "CCW-702," "CCW-1402 Primer/Adhesion Enabler," or Hardcast "GlasGrip-658" adhesive.
  - 4. Abuse Resistant Gypsum Board (Corridor Walls, Classrooms and Other Student Access Rooms, Except Toilet and Shower Rooms): ASTM C 1629, Level 1 surface indentation and soft body impact and level 3 surface abrasion, UL Classified for fire resistance (Type X), mold resistant (ASTM D 3273); Georgia-Pacific Gypsum LLC "DensArmour Plus Abuse-Resistant Interior Panels," 5/8- inch thick.
- B. Cementitious Backer Cementitious Backer Units (Toilet and Shower Rooms): ANSI A118.9

and ASTM C 1288 or C 1325; U.S. Gypsum "Durock Cement Board," James Hardie Building Products "Hardiebacker," or National Gypsum Company "Permapase Cement Board."

## 2.4 MISCELLANEOUS MATERIALS, ACCESSORIES, AND TRIM

- A. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
  - 1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
  - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- B. Galvanized steel casing beads, corner beads, and other metal trim accessories as required.
- C. Joint Tape: ASTM C 475, plain or perforated.
- D. Interior Joint Compound: ASTM C 475 in two grades; one for bedding tape and filling depressions and one for topping and sanding.
- E. Joint Compound for Water Resistant Backing Board: Setting type for filling joints and treating fastener heads.
- F. Acoustical Sealant: See Section 07 92 00 – Joint Sealants.
- G. Acoustical Foam Double Stick Tape: Norton Plastics Corp., V740 Multipurpose medium density foam tape, 1/4" x 2" wide.
- H. Electrical box sound pads by Harry Lowery & Associates, Sun Valley, CA, (Tel) 818-768-4661.
- I. Acoustical Foam Gasket: Norton foam sealant tape, 1-1/2" x 1/8".

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Coordination with Sprayed Fire-Resistive Materials:
  - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling runners (tracks) to surfaces indicated to receive sprayed-on fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than 24 inches o.c.
  - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of gypsum board assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire resistance rating indicated. Protect remaining fire-resistive materials from damage.

### 3.3 INSTALLING STEEL FRAMING, GENERAL

- A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation, except as follows:
  - 1. Partitions With Brittle Finishes: Use stud manufacturer's published limiting heights for

- construction and single span conditions with a limiting deflection of  $L/360$  and uniform transverse load values as indicated on the Drawings.
2. Partitions Without Brittle Finishes, More Than 10'-0" High: Use stud manufacturer's published limiting heights for construction and single span conditions with a limiting deflection of  $L/240$  and uniform transverse load values as indicated on the Drawings.
  3. Do not bridge building expansion joints with support system. Frame both sides of joints with supports as indicated.
  4. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar work to comply with details indicated or if not otherwise indicated, to comply with applicable published recommendations of gypsum board manufacturer, or if not available, of "Gypsum Construction Handbook" published by US Gypsum Co.
  5. Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.
  6. Install runner tracks at floors, ceilings, and structural walls and columns where gypsum board stud system abuts other work, except as otherwise indicated.
  7. Terminate partition stud system at ceilings, except where indicated to be extended to structural support or substrate above.
  8. Space studs 16" o.c., unless otherwise indicated.
  9. Frame door openings to comply with details indicated. If not shown, comply with applicable published recommendations of gypsum board manufacturer or of "Gypsum Construction Handbook" published by U. S. Gypsum Co. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for jack studs) at head and secure to jamb studs.
  10. Frame openings other than door openings to comply with details indicated or if not indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.
  11. Space wall furring members 24" o.c., unless otherwise indicated.

### 3.4 INSTALLING CEILING SUPPORT SUSPENSION SYSTEMS

- A. Secure hangers to structural support by connecting directly to structure where possible; otherwise connect to inserts or other direct pullout type anchorage devices as specified.
- B. Suspend ceiling hangers from building structure as follows:
  1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or ceiling suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, counter splaying, or other equally effective means.
  2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with the location of hangers required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
  3. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eyescrews, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause them to deteriorate or otherwise fail.
  4. Do not support ceilings directly from permanent metal forms. Furnish cast-inplace hanger inserts that extend through forms.
  5. Do not attach hangers to steel deck tabs.
  6. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  7. Do not connect or suspend steel framing from ducts, pipes, or conduit.

- C. Space main runners 4'-0" o.c. and space hangers 4'-0" o.c. along runners, except as otherwise shown.
- D. Level main runners to a tolerance of 1/8" in 12'-0", measured both lengthwise on each runner and transversely between parallel runners.
- E. Furring Bar Suspension Support System: Attach perimeter wall track or angle wherever support system meets vertical surfaces. Mechanically joint support members to each other and butt-cut to fit into wall track.
  - 1. Main Runners: Support directly from wire hangers spaced at 4' o.c.; locate not more than 6" from parallel walls and space not more than 4' o.c., between parallel walls. Install manufacturer's standard splicing device at joints.
  - 2. Cross Runners: Support by interlocking ends of cross runners with main runners to form 90 degree angle between intersecting runners. Locate not more than 6" from parallel walls and space not more than 24" o.c.
  - 3. Other Components: Provide as recommended by manufacturer for support of other work resting in, or on, ceiling.
  - 4. Install auxiliary framing at termination of board work, and at openings for light fixtures and similar work, as required for support of both the board construction and other work indicated for support thereon.
- F. Carrying Channel and Rigid Furring Channel Suspension System: Attach 1-1/2" carrying channels (main runners) to hangers at maximum 48" on center. Install rigid furring channels at maximum 16" on center. Level support system to a tolerance of 1/8" in 12'-0", measured both lengthwise on each channel and transversely across adjacent parallel channels. Install auxiliary framing at termination of board work, and at openings for light fixtures and similar work, as required for support of both the board construction and other work indicated for support thereon. Cold rolled steel channels shall weigh not less than 300-lb./1000 lf. for 3/4-inch size, and 475-lb./1000 lf for 1-1/2- inch size; rust-inhibitive paint for interior locations except hot-dipped galvanized at "high humidity" areas.

### 3.5 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.
- C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- E. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- G. Attach gypsum panels to framing provided at openings and cutouts.

- H. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- I. Form control and expansion joints with space between edges of adjoining gypsum panels.
- J. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
  - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  - 2. Fit gypsum panels around ducts, pipes, and conduits.
  - 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
  - 4. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
  - 5. STC-Rated Assemblies: Seal construction at perimeters, behind control and expansion joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through gypsum board assemblies, including sealing partitions above acoustical ceilings.
  - 6. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

### 3.6 SINGLE LAYER APPLICATION

- A. Partition/Walls: Apply gypsum board vertically with vertical joints located over supports, but offset at least one stud space on opposite faces of partition/walls. Use maximum practical length boards to minimize end joints.
- B. Ceilings: Apply gypsum board with long dimension at right angles to supports with end joints located over supports. Use maximum practical length boards to minimize end joints. Stagger end joints in alternate courses of boards and locate as far away from center of ceiling as possible.

### 3.7 DOUBLE LAYER APPLICATION

- A. Mechanically Fastened Layers: Fasten both layers to supports with screws. For base layer, do not exceed 24" o.c. spacing at edges and intermediate supports, and for face layer do not exceed 16" o.c. spacing along supports of non-fire rated construction. At fire rated construction, comply with requirements of fire rated design indicated.
- B. On walls, apply both layers vertically with vertical joints staggered on opposite side of partitions and offset not less than 12" between layers.
- C. On ceilings, apply first layer as specified for single layer application prior to wall face layer application; apply face layer on ceiling, offsetting joint between layer at least one back-up member spacing in both directions.

### 3.8 INSTALLATION OF BOARD TRIM AND ACCESSORIES, GENERAL

- A. Where feasible, use the same fasteners, to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges by nailing or stapling in accordance with manufacturer's instructions and recommendations.
  - 1. Install metal corner beads at external corners of board work.
  - 2. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed. Provide type with face flange to receive joint compound. Install L-type trim where work is tightly abutted to other work, and install special kerf-type where other work is kerfed to receive long leg of L-type trim. Install U-type trim where edge is exposed, revealed, gasketed, or sealant filled (including expansion joints).

### 3.9 INSTALLATION OF GYPSUM SHEATHING

- A. Except as otherwise indicated, comply with manufacturer's instructions and industry standards for the installation of gypsum sheathing.
  - 1. Install 2-foot wide panels horizontally with V-grooved edge down, and with end joints on supports and staggered two support spacings where possible, but not less than one support spacing or 12-inches.
  - 2. Fasten at each support with four screws (spaced approximately 8-inches on center) set back 3/8-inch minimum from edge.
  - 3. Cut boards at penetrations, edges, and other obstructions of the work; fit tight against abutting work, except provide 3/8-inch setback where non- load bearing work abuts structural elements at head and jambs.
  - 4. Do not bridge building expansion joints with gypsum sheathing; cut and space edges to match spacing of structural support elements.

### 3.10 FINISHING GYPSUM BOARD ASSEMBLIES

- A. Apply treatment at gypsum board joints (both directions), flanges of trim accessories, penetrations, fastener heads, surface defects and elsewhere as required to prepare work for decoration. Prefill open joints and rounded or beveled edges, if any, using type of compound recommended by manufacturer.
- B. Exposed Board to Receive Paint and Other Finishes (Except Tile): Apply joint compound in 3 coats (not including prefill of openings in base), and sand between last two coats and after last coat.
- C. Concealed Board: Omit third coat and sanding on concealed board work which is not indicated for board finishing or for which finishing is not required to achieve fire resistance rating, sound rating or to act as air or smoke barrier.
- D. Water-Resistant Backing Board Tiled Areas: Comply with recommendations of gypsum backing board manufacturer for treatment of joints behind ceramic tile.
  - 1. Treat fastener heads with water-resistant joint compound.
  - 2. Fill tapered edges in gypsum panels with water-resistant joint compound, embed joint tape firmly and wipe off excess compound; follow immediately with a second coat of water-resistant joint compound over taping coat, being careful not to crown the joint.
  - 3. Fold and embed tape in all interior angles to form true angles.
  - 4. In water-resistant backing board areas not to be tiled, treat fastener heads and embed tape as indicated above using water-resistant joint compound but finish with two coats of joint compound used for regular gypsum board work.
- E. Provide the following levels of gypsum board finish per ASTM C 840 and GA-214:
  - 1. Level 0: Gypsum board within unfinished areas; taping, floating and trim is not required.
  - 2. Level 1: Gypsum board within ceiling plenum areas, concealed areas, unless a higher

- finish is required for fire resistance rated assemblies and sound rated assemblies.
3. Level 2: Gypsum board substrates to receive ceramic tile and similar solid finish materials.
  4. Level 3: Gypsum board ceiling and wall surfaces to receive flat and satin paint over non-textured surfaces.
  5. Level 4: Gypsum board wall surfaces to receive flat or semi-gloss paint and.
  6. Level 5: Gypsum board ceiling and wall surfaces specified to receive gloss paint and other reflective applied finishes over non-textured surfaces.

END OF SECTION

**09 30 00**

**TILING**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes furnishing and installing:
  - 1. Thin set unglazed porcelain mosaic tile at floor and base areas indicated.
  - 2. Thin set mortar for thin set floor tile.
  - 3. Organic adhesive for wall tile installation.
  - 4. Unsanded grout at wall, base, and floor tile.
- B. Related Work of Other Sections:
  - 1. Section 03 30 00 – Cast-In-Place Concrete.
  - 2. Section 06 10 00 – Rough Carpentry.
  - 3. Section 07 92 00 – Joint Sealants.
  - 4. Section 09 21 16 – Gypsum Board Assemblies for cementitious tile backing boards.
  - 5. Section 10 28 13 – Toilet Accessories.
  - 6. Section 10 21 13 19 – Solid Plastic Toilet Compartments.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for manufactured products and accessories.
- B. Samples: Submit grout color samples. If requested by Architect provide grouted actual tile samples, approximately 1-ft sq., of each type and color of tile and grout required.

1.4 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

**PART 2 PRODUCTS**

2.1 PRODUCTS AND MANUFACTURERS

- A. Tile Selections:
  - 1. Refer to Finish Legend on the Drawings for tile selections, sizes, color and texture required and to Finish Schedule for locations required.

2.2 SETTING MATERIALS, GROUT AND ACCESSORIES

- A. Use the following setting materials and grout in accordance with ANSI A 108 series installation specifications indicated and Tile Council of American "Ceramic Tile: The Installation Handbook".
- B. Dry-Set Mortar (Thin Set Floors): Bostik "Tile-Mate 710/713" with "Hydroment Multi-Purpose Acrylic Additive", complying with ANSI A 118.1 and ANSI A 108.5 installation specifications. Subject to compliance with requirements, provide equivalent products by C-Cure, Mapei or Texas Cement Products will be acceptable as approved.
- C. Organic Tile Adhesive (Thin Set Walls): Bostik "7001 Mastic", complying with ANSI A 136.1, Type I, and ANSI A 108.4 installation specifications. Subject to compliance with requirements, provide equivalent products by C-Cure, Mapei or Texas Cement Products will be acceptable as approved.
- D. Grout: ANSI A118.6; Laticrete 1600 Series (Unsanded), in colors as selected by Architect. Subject to compliance with requirements, provide equivalent products by C-Cure, Bostik, Mapei, or Texas Cement Products will be acceptable as approved. Install grout in accordance with ANSI A108.10 installation specifications.
  - 1. Grout Colors: Refer to Finish Legend and Finish Schedule on the Drawings for product selections, colors, sizes and locations.
- E. Metal Edge Trim: Schuter-Systems Rondec-Step finishing and edging profile with 1 1/2" Leg.

### **PART 3 EXECUTION**

#### **3.1 EXAMINATION**

- A. Examine the areas and conditions under which ceramic tile work is to be applied and do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

#### **3.2 PREPARATION**

- A. Preparation of Subfloors: Prior to start of applying ceramic tile work, broom clean, or vacuum surfaces to be covered and inspect the subfloor. Start of application operations will indicate acceptance of surface conditions and full responsibility for the completed work.

#### **3.3 TILE BACKING PANEL INSTALLATION**

- A. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated.

#### **3.4 INSTALLATION**

- A. Comply with the applicable parts of ANSI A 108 series of tile installation standards included under "American National Standard Specifications for the Installation of Ceramic Tile" and the Tile Council of America "Ceramic Tile: The Installation Handbook".
  - 1. Dry-Set (Thin-Set) Floor Tile and Glass Wall Tile: ANSI A108.5.
  - 2. Organic Adhesive Set Wall Tile: ANSI A 108.4.
  - 3. Tile Set in Portland Cement Mortar Bed: ANSI A 108.1.
  - 4. Sanded and Dry-Set Tile Grout: ANSI A108.10
- B. Handle, store, mix, and apply proprietary setting and grouting materials in compliance with the manufacturer's instructions.

- C. Extend tile work into recesses and under fixtures to form a complete covering without interruptions. Terminate work neatly at obstructions, edges, and corners without disruption of pattern or joint alignment.
- D. Jointing Pattern: Lay tile with joint pattern to produce design indicated. Align joints on floor, base, walls, and trim. Lay out tile work and center tile field in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform grouted joint widths.
- E. Expansion and Control Joints: Provide where shown, and as recommended in the TCNA "Handbook for Ceramic Tile Installation". Install removable strips of the same depth as the finished tile system. Remove strips after grouting and curing operations. Refer to Section 07 92 00 for sealants.

### 3.5 GROUT INSTALLATION

- A. Use unsanded cement grout for grouting wall and floor tile joints.
- B. Use sanded cement grout for grouting large format tile.

### 3.6 CLEANING

- A. Unglazed tile may be cleaned with acid solutions only when permitted by the tile and grout manufacturer's printed instructions, but not sooner than ten days after installation.
- B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and other defective tile work.
- C. Protection: Protect installed ceramic tile work with Kraft paper or other heavy covering during the construction period to prevent damage and wear.

END OF SECTION

**09 67 23**

**RESINOUS FLOORING**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes furnishing and installing resinous flooring with integral base over cured concrete flooring and base, installation of crack isolation membrane at existing cracks, continuation of resinous flooring as indicated and required for a complete seamless resinous flooring installation in the food preparation and serving line floor and base areas shown.

1.3 RELATED WORK

- A. Related Work of Other Sections:
  - 1. Section 02 00 00 – Existing Conditions.
  - 2. Section 02 41 19 – Selective Demolition
  - 3. Section 09 20 00 – Gypsum Board and Light-Gage Metal Framing
  - 4. Division 26 Sections: Electrical distribution and devices.

1.4 SUBMITTALS

- A. Product Data: For each type of product specified. Include manufacturer's technical data, installation instructions, and recommendations for each resinous flooring component required.
- B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors, textures, and patterns available for each resinous flooring system indicated.
  - 1. Samples for Verification: Of each resinous flooring system required, 6 inches (150 mm) square, applied by Installer for this Project to a rigid backing, in color, texture, and finish to match existing flooring as approved by Architect. Where finishes involve normal color and texture variations, include Sample sets showing the full range of variations expected.
- C. Maintenance Data: For resinous flooring to include in the maintenance manuals specified in Division 1.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced installer (applicator) who has specialized in installing resinous flooring similar in material, design, and extent to that indicated for this Project and who is acceptable to resinous flooring manufacturer.
  - 1. Engage an installer who employs only persons trained and approved by resinous flooring manufacturer for installing resinous flooring systems specified.
  - 2. Engage an installer who is certified in writing by resinous flooring manufacture as qualified to install resinous flooring systems specified.

- B. Source Limitations: Obtain primary resinous flooring materials, including primers, resins, hardening agents, and sealing or finish coats, through one source from a single manufacturer. Provide secondary materials including patching and fill material, joint sealant, and repair materials of type and from source recommended by manufacturer of primary materials.
- C. Field Samples: On floor area selected by Architect, provide full-thickness resinous flooring system samples that are at least 48-inches (1200-mm) square to demonstrate texture, color, thickness, chemical resistance, cleanability, and other features of each resinous flooring system required. Simulate finished lighting conditions for review of in-place field samples.
  - 1. If field samples are unacceptable, make adjustments to comply with requirements and apply additional samples until field samples are approved.
  - 2. After field samples are approved, these surfaces will be used to evaluate resinous flooring.
  - 3. Obtain Architect's approval of field samples before applying resinous flooring.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating brand name and directions for storage and mixing with other components.
- B. Store materials to comply with manufacturer's written instructions to prevent deterioration from moisture, heat, cold, direct sunlight, or other detrimental effects.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with resinous flooring manufacturer's written instructions for substrate temperature, ambient temperature, moisture, ventilation, and other conditions affecting resinous flooring installation.
- B. Lighting: Provide permanent lighting or, if permanent lighting is not in place, simulate permanent lighting conditions during resinous flooring installation.
- C. Close spaces to traffic during resinous flooring application and for not less than 24 hours after application, unless manufacturer recommends a longer period.

### **PART 2 PRODUCTS**

#### 2.1 SEAMLESS RESINOUS FLOORING

- A. "Dur-A-Quartz" Floor System as manufactured by Dur-A-Flex, or equivalent by Stonhard, Inc., or Dudick, Inc.; and as follows:
  - 1. Primer Coat, Dur-A-Glaze #4WB by Dur-A-Flex, or equivalent by Stonhard or Dudick.
  - 2. Broadcast Coat and Grout Coat, Dur-A-Glaze #4 by Dur-A-Flex, or equivalent by Stonhard or Dudick.
  - 3. Topcoat, Armor Top by Dur-A-Flex, or equivalent by Stonhard or Dudick.
  - 4. Standard, slip resistant texture in color from Owner's standard range.
  - 5. Uniform total thickness of 0.125-inch.

### **PART 3 EXECUTION**

#### 3.1 EXAMINATION

- A. Examine substrates, areas and conditions, with Applicator present, for compliance with requirements for maximum moisture content, installation tolerances and other conditions

affecting flooring performance.

1. Verify that substrates and conditions are satisfactory for flooring installation and comply with requirements specified.

### 3.2 PREPARATION

#### A. General

1. Where floor leveling compound is called for to bring floor surfaces to level or generate necessary slopes for drain/accessibility, the compound shall be installed and cured prior to installation of resinous flooring.
2. New and existing concrete surfaces shall be free of oil, grease, curing compounds, loose particles, moss, algae growth, laitance, friable matter, dirt, and bituminous products.
3. Moisture Testing: Perform tests recommended by manufacturer and as follows.
  - a. Perform anhydrous calcium chloride test ASTM F 1869-98. Application will proceed only when the vapor/moisture emission rates from the slab is less than and not higher than 3 lbs/1,000 sf/24 hrs.
  - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
  - c. If the vapor emission exceeds 75 % relative humidity or 3 lbs/1,000 sf/24 hrs then moisture mitigation system must be installed prior to resinous flooring installation. Existing slabs on grade where presence of vapor barrier is unknown, may also require the moisture mitigation system.
4. There shall be no visible moisture present on the surface at the time of application of the system. Compressed oil-free air and/or a light passing of a propane torch may be used to dry the substrate.
5. Mechanical surface preparation
  - a. Shot blast all surfaces to receive flooring system with a mobile steel shot, dust recycling machine (Blastrac or equal). All surface and embedded accumulations of paint, toppings hardened concrete layers, laitance, power trowel finishes and other similar surface characteristics shall be completely removed leaving a bare concrete surface having a minimum profile of CSP 4-5 as described by the International Concrete Repair Institute.
  - b. Floor areas inaccessible to the mobile blast machines shall be mechanically abraded to the same degree of cleanliness, soundness and profile using diamond grinders, needle guns, bush hammers, or other suitable equipment.
  - c. Where the perimeter of the substrate to be coated is not adjacent to a wall or curb, a minimum 1/4 inch key cut shall be made to properly seat the system, providing a smooth transition between areas. The detail cut shall also apply to drain perimeters and expansion joint edges.
  - d. Cracks and joints (non-moving) greater than 1/8 inch wide are to be chiseled or chipped-out and repaired per manufacturer's recommendations.
6. At spalled or worn areas, mechanically remove loose or delaminated concrete to a sound concrete and patch per manufactures recommendations.

### 3.3 APPLICATION

#### A. General

1. The system shall be applied in six distinct steps as listed below:
  - a. Substrate preparation
  - b. Priming
  - c. First broadcast coat application with first aggregate broadcast
  - d. Second broadcast coat with second aggregate broadcast
  - e. Grout coat application, sand floor (if required)

- f. Topcoat application
  2. Immediately prior to the application of any component of the system, the surface shall be dry and any remaining dust or loose particles shall be removed using a vacuum or clean, dry, oil-free compressed air.
  3. The handling, mixing and addition of components shall be performed in a safe manner to achieve the desired results in accordance with the Manufacturer's recommendations.
  4. The system shall follow the contour of the substrate unless pitching or other leveling work has been specified by the Architect.
  5. A neat finish with well-defined boundaries and straight edges shall be provided by the Applicator.
- B. Primer
1. The primer shall consist of a liquid resin and hardener that is mixed at the ratio of 1 part resin to 4 parts hardener per the manufacturer's instructions.
  2. The primer shall be applied by 1/8 inch notched squeegee and back rolled at the rate of 200-250 sf/gal to yield a dry film thickness of 4 mils.
- C. Broadcast Coat
1. The broadcast coat shall be applied as a double broadcast system as specified by the Architect.
  2. The broadcast coat shall be comprised of two components, a resin, and hardener as supplied by the Manufacturer and mixed in the ratio of 2 parts resin to 1 part hardener.
  3. The resin shall be added to the hardener and thoroughly mixed by suitably approved mechanical means.
  4. The broadcast coat shall be applied over horizontal surfaces using "v" notched squeegee and back rolled at the rate of 90-100 sf/gal.
  5. Colored quartz aggregate shall be broadcast to excess into the wet material at the rate of 0.5 lbs/sf.
  6. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
  7. Apply a second coat of resin with a coverage rate of 90-100 sf/gal and broadcast aggregate to excess at the rate of 0.5 lbs/sf.
  8. Allow material to fully cure. Vacuum, sweep and/or blow to remove all loose aggregate.
- D. Grout Coat
1. The grout coat shall be comprised of a liquid resin and a liquid hardener that is mixed in the ratio of 1 part hardener to 2 parts resin and installed per the manufacturer's recommendations.
  2. The grout coat shall be squeegee applied and back rolled with a coverage rate of 90-100 sf/gal.
- E. Topcoat
1. The topcoat of Armor Top shall be roller applied at the rate of 500 sf/gal to yield a dry film thickness of 3 mils.
  2. topcoat shall be comprised of a liquid resin, hardener and grit that is mixed per the manufacturer's instructions.
  3. The finish floor will have a nominal thickness of 1/8 inch.

### 3.4 CLEANING AND PROTECTING

- A. Protect resinous flooring from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by resinous flooring manufacturer.

- B. Clean resinous flooring not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each Project area. Use cleaning materials and procedures recommended in writing by resinous flooring manufacturer.
- C. Demonstration: Review cleaning procedures and cleaning materials that the Owner's staff use to confirm that materials and procedures will provide required cleaning results and protection to resinous flooring system.

END OF SECTION

**09 90 00**

**PAINTING AND COATING**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of painting and coating systems on the following substrates:
1. All exterior ferrous metals, except as specified.
  2. All exterior non-ferrous metals, except as specified.
  3. Exterior concrete and plaster with painted finish.
  4. Interior wood with painted finish.
  5. All interior ferrous metals, except as specified.
  6. All interior non-ferrous metals, except as specified.
  7. Interior concrete masonry with painted finish.
  8. Interior concrete and plaster with painted finish.
  9. Interior gypsum drywall with painted finish.
  10. All prime coated hardware and other factory primed metal items.
  11. All prime coated hardware and other factory primed metal items.
  12. Exposed fire protection piping, valves and standpipes, excluding sprinkler heads, valve tags, name plates, and exposed operating components of motors and pumps.
  13. Exposed pipe, pipe hangers and supports, heat exchangers, tanks, piping and equipment insulation, plumbing and ductwork, motor shafts and mechanical equipment within garage and central plant rooms. Painting work excludes similar equipment located in mechanical fan (AHU Equipment) rooms.
  14. All metal grilles, except anodized aluminum, unless otherwise indicated.
  15. Exposed conduit, raceway, boxes, switchgear and electrical cabinets, excluding items located in mechanical fan (AHU Equipment) rooms.
  16. Items normally requiring painting or finishing, or which are indicated to be painted or finished.
  17. Where an item is not specifically mentioned, paint same as similar adjacent materials or surfaces.
- B. Make test patches to verify coating system compatibility and adhesion over existing coatings and surfaces.
- C. Do not include painting of:
1. Prefinished or factory finished items (e.g., shop finished woodwork and casework, acoustic materials, and similar items).
  2. Aluminum, copper, chromium and other plated finishes.
  3. Concealed surfaces in concealed and inaccessible areas including furred-areas, pipe chases, duct shafts, and similar spaces.
  4. Operating parts of fire protection, plumbing, mechanical, and electrical equipment, including sensing devices, motor and fan shafts, and sprinkler heads.
  5. Code required labels and nomenclature plates.

6. Exposed data and communication wiring and wiring devices.

### 1.3 RELATED WORK

- A. Related Work of Other Sections:
  1. Section 03 30 00 "Cast-in-Place Concrete."
  2. Section 04 20 00 "Unit Masonry" for loose lintels, anchor bolts, and other items built into unit masonry.
  3. Section 05 12 00 "Structural Steel Framing" for shop priming of steel framing substrates.
  4. Section 05 31 00 "Steel Decking" for touch-up painting of steel decking welds.
  5. Section 05 50 00 "Metal Fabrications" for shop priming of metal fabrication substrates.
  6. Section 06 40 00 "Architectural Woodwork" for shop finishing of woodwork items.
  7. Section 07 62 00 "Sheet Metal Flashing and Trim" for factory coil-coated materials.
  8. Section 07 70 00 "Roof Accessories and Specialties."

### 1.4 DEFINITIONS

- A. Painting and Coating Systems: Include coating system materials such as primers, emulsions, enamels, stains, sealers and fillers, and other applied materials whether used as prime, intermediate or finish coats. Paint and coating work includes surface preparation and cleaning, primer touch-up of shop primed items, repair of existing coatings (including barrier coats required to properly apply new coating systems), field priming and painting exterior and interior material, equipment and appurtenances.
- B. Gloss Levels:
  1. Gloss Level G1 (Traditional Matt Finish – Flat): Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
  2. Gloss Level G2 (Velvet): Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
  3. Gloss Level G3 (Traditional Eggshell): 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
  4. Gloss Level G4 (Satin): 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
  5. Gloss Level G5 (Traditional Semi-Gloss): 35 to 70 units at 60 degrees, according to ASTM D 523.
  6. Gloss Level G6 (Traditional Gloss): 70 to 85 units at 60 degrees, according to ASTM D 523.
  7. Gloss Level G7 (High Gloss): More than 85 units at 60 degrees, according to ASTM D 523.

### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Initial Selection: For each type of topcoat product.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
  1. Submit Samples on rigid backing, 8 inches square.
  2. Step coats on Samples to show each coat required for system.
  3. Label each coat of each Sample.
  4. Label each Sample for location and application area.
  5. Resubmit samples until required color sheen and texture are approved.

- D. Application Schedule: Submit a schedule of paint system exposure, substrates and painting manufacturer's product data for barrier, prime, intermediate and topcoats, application instructions and application equipment recommended by painting manufacturer for application methods scheduled. For each product indicated, include the following:
  - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
  - 2. VOC content.

#### 1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

#### 1.7 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
    - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft.
    - b. Other Items: Architect will designate items or areas required.
  - 2. Final approval of color selections will be based on mockups.
    - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
  - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Quality Grade: Provide manufacturer's best quality trade sale paint material of coating types specified. Use only material Manufacturer's containers with intact labels with product identification.
- C. Coating Systems: Provide primers, finish coat materials, and related materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by the manufacturer based on testing and field experience.
- D. Color Designations and Selections: Subject to compliance with requirements, names used to designate colors are not intended to imply that manufacturers or products named are required to the exclusion of specified products of other manufacturers. Match colors indicated by reference to manufacturer's standard color designations.
- E. Pigments: Use color pigments that are pure, non-fading, suitable for substrates and service indicated. Lead content in pigment, if any, is limited to contain not more than 0.06% lead, as lead metal based on the total non-volatile (dry-film) of paint by weight. This limitation is extended to interior surfaces and those exterior surfaces, such as stairs, decks, porches, railings, windows, and doors that are readily accessible to children under 7 years of age.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

#### 1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

### **PART 2 PRODUCTS**

#### 2.1 MANUFACTURERS

- A. Coating Systems Products: Subject to compliance with requirements, provide products of one of the following for each substrate indicated:
  1. Benjamin Moore & Co.(Moore)
  2. PPG Paints. (formally Pittsburg Paints & Glidden Professional (GP)
  3. Pratt & Lambert (P & L)
  4. Sherwin-Williams Company (The) (S-W)
  5. Behr Process Corporation (Behr)
- B. Basis of Design: Refer to color schedule for Basis of Design paint selection.

#### 2.2 PAINT, GENERAL

- A. Material Compatibility:
  1. Provide materials for use within each paint substrate system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated
- B. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  1. Flat Paints and Coatings: 50 g/L.
  2. Nonflat Paints and Coatings: 150 g/L.
  3. Dry-Fog Coatings: 400 g/L.
  4. Primers, Sealers, and Undercoaters: 200 g/L.
  5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
  6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
  7. Pretreatment Wash Primers: 420 g/L.
  8. Floor Coatings: 100 g/L.
  9. Shellacs, Clear: 730 g/L.
  10. Shellacs, Pigmented: 550 g/L.
- C. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Colors: As indicated in a color schedule.

## 2.3 EXTERIOR PAINTING SYSTEMS AND MATERIALS

- A. Exterior Ferrous Metal:
1. Latex Semi-Gloss Enamel: 2 finish coats over primer.
    - a. Primer: Rust Inhibitive Latex Primer.
      - 1) PPG: Devflex 4020PF Direct to Metal Primer & Flat Finish
      - 2) Benjamin Moore: Acrylic Metal Primer M04
      - 3) Sherwin Williams: Pro Industrial Pro Cryl Universal Primer B66W310
      - 4) Behr: Premium Plus Multi-Surface Primer & Sealer 436
    - b. First and Second Finish Coats: Exterior Semi-Gloss Latex Enamel.
      - 1) PPG: Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel
      - 2) Benjamin Moore: DTM Acrylic Semi-Gloss M29
      - 3) Sherwin Williams: Pro Industrial 0 VOC Acrylic Semi-Gloss
      - 4) Behr: Direct To Metal Semi-Gloss Paint 3200
- B. Exterior Non-Ferrous Metal (Zinc Coated Steel and Aluminum):
1. Latex Semi-Gloss Enamel: 2 finish coats over primer.
    - a. Primer: Latex Galvanized Metal Primer.
      - 1) PPG: Devflex 4020PF Direct to Metal Primer & Flat Finish
      - 2) Benjamin Moore: Acrylic Metal Primer M04
      - 3) Sherwin Williams: Pro Industrial Pro Cryl Universal Primer B66W310
      - 4) Behr: Premium Plus Multi-Surface Primer & Sealer 436
    - b. First and Second Finish Coats: Exterior Semi-Gloss Latex Enamel.
      - 1) PPG: Devflex 4216HP High Performance Waterborne Acrylic Semi-Gloss Enamel
      - 2) Benjamin Moore: DTM Acrylic Semi-Gloss M29
      - 3) Sherwin Williams: Metalatex Semi-Gloss Enamel B42W110
      - 4) Behr: Direct To Metal Semi-Gloss Paint 3200
- C. Exterior Concrete:
1. Acrylic Low Luster (Flat) Elastomeric Masonry Coating: 2 coats over alkali resistant primer with total dry film thickness not less than 2 mils
    - a. Primer Coat: Exterior Latex Flat Paint.
      - 1) PPG: Perma-Crete 4-603 Int/Ext Alkali Resistant Primer
      - 2) Benjamin Moore: Moorcraft Super Spec Exterior Flat 180
      - 3) Sherwin Williams: Loxon Masonry Primer A24W8300
      - 4) Behr: Premium Plus Multi-Surface Primer & Sealer 436
    - b. Finish Coats: Two rolled-on or brushed-on coats of elastic masonry coating.
      - 1) PPG: Perma-Crete Pitt-Flex 4-110 Elastomeric Costing
      - 2) Benjamin Moore: Moorlastic Acrylic Elastomeric Waterproof Coating Flat 056
      - 3) Sherwin Williams Loxon A24W350 Topcoat or Sherlastic Elastomeric A5-100
      - 4) Behr: Exterior Elastomeric Masonry Stucco & Brick Paint 68

## 2.4 INTERIOR PAINTING SYSTEMS AND MATERIALS

- A. Interior Wood - Painted:
1. Latex Eggshell Low Odor Finish: 2 finish coats over primer.
    - a. Primer: Latex-Based Interior Low-Odor White Primer.
      - 1) PPG: Seal Grip 17-921 Latex Primer
      - 2) Benjamin Moore: Eco Spec Interior Latex Primer Sealer 231
      - 3) Sherwin Williams: Pro Green 200 Low Odor VOC Primer B28W600
      - 4) Behr: Premium Plus All-In-One Primer & Sealer 75

- b. First and Second Finish Coats: Latex-Based Interior Eggshell Enamel.
  - 1) PPG: Ultra Hide 250 1402 Eggshell (Pure Performance 9-300 Eggshell 0VOC)
  - 2) Benjamin Moore: Eco Spec Interior Latex Eggshell Enamel 223
  - 3) Sherwin Williams: Pro Green 200 Low Odor VOC Eg-Shell B20W651
  - 4) Behr: Behr Pro i300 Interior Eggshell 330
  
- B. Interior Ferrous Metal:
  - 1. Latex Semi-Gloss Low Odor Finish: 2 finish coats over primer.
    - a. Primer: Latex-Based Interior Low-Odor White Primer.
      - 1) PPG: Speedhide 6-2 Interior Latex Sealer
      - 2) Benjamin Moore: Eco Spec Interior Latex Primer Sealer 231
      - 3) Sherwin Williams: Pro Green 200 Low Odor Low VOC Primer B28W600
      - 4) Behr: Premium Plus Multi-Surface Primer & Sealer 436
    - b. First and Second Finish Coats: Latex-Based Interior Semi-Gloss Enamel.
      - 1) PPG: Speedhide 6-500 Semi-Gloss (Pure Performance 9-500 Semi Gloss 0VOC)
      - 2) Benjamin Moore: Eco Spec Interior Latex Semi Gloss 224
      - 3) Sherwin Williams: Pro Green 200 Latex Semi-Gloss B31W651
      - 4) Behr: Behr Pro i300 Interior Semi-Gloss 370
  
  - C. Interior Non-Ferrous Metal (Zinc Coated Steel and Aluminum):
    - 1. Latex Semi-Gloss Low Odor Finish: 2 finish coats over primer.
      - a. Primer: Latex-Based Interior Low-Odor White Primer.
        - 1) PPG: Devflex 4020PF Direct to Metal Primer & Flat Finish
        - 2) Benjamin Moore: Eco Spec Interior Latex Primer Sealer 231
        - 3) Sherwin Williams: Pro Industrial Pro Cryl Universal Primer B66W310
        - 4) Behr: Premium Plus Multi-Surface Primer & Sealer 436
      - b. First and Second Finish Coats: Latex-Based Interior Semi-Gloss Enamel.
        - 1) PPG: Ultra Hide 250 1406 Semi-Gloss
        - 2) Benjamin Moore: Eco Spec Interior Latex Semi Gloss 224
        - 3) Sherwin Williams: Pro Green 200 Latex Semi-Gloss
        - 4) Behr: Behr Pro i300 Interior Semi-Gloss 370
    - 2. Primer/Waterborne Dryfall Topcoat (Interior Exposed Conduit, Electrical Boxes, Piping, Ductwork, Hangers and Hanger Wire, and Steel Deck):
      - a. Surface Preparation: Solvent clean in accordance with SSPC SP1. Use clean tack cloth. All surfaces must be clean and dry.
      - b. Primer: Water based metal primer or alkyd metal primer tinted to match topcoat.
        - 1) PPG: Devflex 4020PF Direct to Metal Primer & Flat Finish
        - 2) Benjamin Moore: Universal Metal Primer M07
        - 3) Sherwin Williams: Pro Industrial Pro Cryl Universal Primer B66W310
        - 4) Tnemec: Spra-Saf EN Series 30
        - 5) Behr: Premium Plus Multi-Surface Primer & Sealer 436
      - c. Waterborne Acrylic Dryfall Finish: Provide one sprayed on coat of one of the following:
        - 1) PPG: Speedhide Super Tech Interior Dry-Fog Flat Latex 6-723XI
        - 2) Benjamin Moore: Sweep-Up Spray Latex Flat M53
        - 3) Sherwin Williams: Waterborne Acrylic Dryfall B42W2 (SG)
        - 4) Tnemec: Spra-Saf EN Series 30
        - 5) Behr: Behr Pro Dryfall 890 Flat White Base, 891 Flat Black
  
    - D. Interior Concrete Masonry Units:
      - 1. Acrylic Epoxy Gloss Finish: 1 finish coat over filled surface with a total dry film thickness not less than 2.0 mils, excluding block filler.

- 
- a. Filler Coat: High-performance latex block filler tinted to match topcoat. Apply at a rate to ensure complete coverage with pores filled.
    - 1) PPG: Speedhide Int/Ext 6-15 Acrylic Block Filler
    - 2) Benjamin Moore: Latex Block Filler M88
    - 3) Sherwin Williams: Heavy Duty Block Filler (B42W46)
    - 4) Behr: Behr Pro Block Filler Primer 50
  - b. Finish Coat: Two Part Low-Odor Acrylic Epoxy.
    - 1) PPG: Pitt-Glaze WB 16-551 High Solid Acrylic Epoxy; 2.25 - 2.7 mils DFT. VOC: Maximum 1.39 lb. /gal.
    - 2) Benjamin Moore: Acrylic Epoxy Coating M43/M44; 1.5 mils DFT/coat VOC: 1.86 lb. /gal
    - 3) Sherwin Williams: Water Based Epoxy (B70-200 Series) VOC: Maximum 1.50 lb. /gal.
    - 4) Behr: Behr Pro Pre-Catalyzed Waterborne Epoxy Semi-Gloss HP150; 1.5-2.0 mils DFT; VOC: <10 g/L
- E. Interior Gypsum Drywall Systems:
- 1. Egg-Shell Prime Coat/Water Based Epoxy Topcoats (Wall Areas): 2 finish coats over primer.
    - a. Primer: Waterborne epoxy, acrylic latex, or alkyd metal primer tinted to match topcoat.
      - 1) Sherwin Williams: ProMar 200 Latex Primer
        - a) VOC – Lb./Gal: 0.71
        - b) Dry Film Thickness – Mils: 1.0 to 1.1
    - b. Finish Coats: Two component low-odor acrylic epoxy. Provide two individual sprayed or rolled on coats with minimum 4 hour curing prior to recoating.
      - 1) Sherwin Williams : B73-360/B73v300 Series
        - a) VOC – Lb./Gal: 1.5
        - b) Dry Film Thickness – Mils: 2.5 to 3.0
      - 2) Tnemec Series 114 H. B.
        - a) VOC – Lb./Gal: 1.88 to 2.20
        - b) Dry Film Thickness – Mils: 4.0 to 6.0
      - 3) Behr: US Coatings AquaGrip 2600 Water Based Epoxy Semi-Gloss
        - a) C – Lb./Gal: .8
        - b) Dry Film Thickness – Mils: 2.0 to 5.0
  - 2. Cut Shellac Varnish Sealer or Alkyd Based Wall Primer (Wall Areas to Receive Wall Covering): 1 primer coat with a dry film thickness of 0.9 mils.
    - a. Primer: Cut Shellac Varnish or Latex or Alkyd Primer/Sealer & Vapor Barrier.
      - 1) PPG : 17-21 Seal-Grip Acrylic Latex Wall Primer/Sealer
      - 2) Benjamin Moore: Moore's Wall-Grip 2
      - 3) Sherwin Williams: PrepRite PreWallcovering Primer B28W8980
      - 4) Behr: Premium Plus All-In-One Primer & Sealer 75
- F. Interior Plaster:
- 1. Latex Lusterless (Flat) Emulsion Finish: 2 coats.
    - a. Primer and Finish Coats: Latex Interior Flat Paint
      - 1) PPG: 6-70 Speedhide Latex Flat Wall Paint
      - 2) Benjamin Moore: Moorcraft Super Spec Latex Flat 275
      - 3) Sherwin Williams: ProMar 200 Latex Flat Wall Paint B30W200 Series
      - 4) Behr: Behr Pro i300 Interior Flat 310

## PART 3 EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Gypsum Board: 12 percent.
  - 5. Plaster: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Plaster Substrates: Verify that plaster is fully cured.
- E. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- F. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- G. Proceed with coating application only after unsatisfactory conditions have been corrected.
  - 1. Application of coating indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 2, "Hand Tool Cleaning."
  - 2. SSPC-SP 3, "Power Tool Cleaning."
  - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
  - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of

shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations.
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
  - 1. Paint the following work where exposed in equipment rooms:
    - a. Equipment, including panelboards and switch gear.
      - 1) Uninsulated metal piping.
      - 2) Uninsulated plastic piping.
      - 3) Pipe hangers and supports.
      - 4) Metal conduit.
      - 5) Plastic conduit.
      - 6) Tanks that do not have factory-applied final finishes.
      - 7) Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material, and internal surfaces of metal

ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

2. Paint the following work where exposed in occupied spaces:
  - a. Equipment, including panelboards.
    - 1) Uninsulated metal piping.
    - 2) Uninsulated plastic piping.
    - 3) Pipe hangers and supports.
    - 4) Metal conduit.
    - 5) Plastic conduit.
    - 6) Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - 7) Other items as directed by Architect.

### 3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
  1. Contractor shall touch up and restore painted surfaces damaged by testing.
  2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

END OF SECTION

**10 21 00**

**TOILET AND SHOWER PARTITIONS**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes furnishing and installing the following:
  - 1. Floor supported overhead braced solid phenolic toilet compartments with Heavy-duty institutional stainless steel hardware.
  - 2. Floor supported overhead braced solid phenolic shower compartments with Heavy-duty institutional stainless steel hardware.
  - 3. Wall mounted urinal screens.

1.3 RELATED WORK

- A. Related Work of Other Sections:
  - 1. Section 06 10 00 – Rough Carpentry: Wood blocking.
  - 2. Section 09 21 16 – Gypsum Drywall Assemblies.
  - 3. Section 09 30 00 – Tiling.
  - 4. Section 10 28 13 – Toilet Accessories.
  - 5. Division 22 – Plumbing.

1.4 SUBMITTALS

- A. Product Data: Submit product data for each type of compartment and screen required, schedule of types, finishes, sizes and locations, color charts and installation and maintenance instructions. Indicate accessories that are to be furnished with each unit.
- B. Shop Drawings: Submit shop drawings for compartment and screen units that are drawn to scale and indicating size and arrangement of units, mounting details, and relationship to supporting and adjacent related work of other Sections.
- C. Samples: Submit samples of solid plastic finishes, approximately 4" x 4" in size. Review of samples will be for color and texture only. Submit samples of each type of hardware, trim, and accessory.

1.5 QUALITY ASSURANCE

- A. Material Quality Assurance: Obtain solid phenolic plastic only from a source with sufficient capacity of consistent color range and texture required for this Project. Solid phenolic plastic shall match approved sample on file in the Architect's office.
- B. Qualifications of Fabricator: Only a firm that has had a minimum of 5 years successful experience in the design and fabrication of solid phenolic plastic compartment work similar to work required for this Project will be acceptable. Fabricator must have sufficient production capacity to design, fabricate, transport and deliver required solid phenolic plastic

compartment work, anchorage and support work without causing delay in the Work. Fabricate solid phenolic plastic compartment work only at a plant engaged in producing similar units.

- C. Dimension Coordination: Coordinate and verify by measurement at the Project Site, dimensions affecting solid phenolic plastic compartments and related work. Submit written notification of field dimensions and conditions that vary from requirements indicated on the Drawings, approved shop drawings, in conflict with ADA and TAS requirements, or are detrimental to proper and timely installation of related work. Where conflicts occur, obtain determination from Architect prior to fabrication of solid phenolic plastic compartment and screen work.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect stone during storage and construction against moisture, soiling, staining, and physical damage.
- B. Handle solid phenolic plastic material to prevent chipping, breakage, soiling, or other damage. Lift with wide-belt type slings wherever possible; do not use wire rope or ropes containing tar or other substances that might cause staining.
- C. Store materials on wood skids or pallets; distribute weight evenly and to prevent breakage or warping of components. Protect stored compartments from weather with waterproof, nonstaining covers or enclosures, but allow air to circulate around packaging.

#### 1.7 JOB CONDITIONS

- A. Installer must review installation procedures and coordination with other work, with Contractor, and other contractors and subcontractors whose work will be affected by compartment work.

#### 1.8 WARRANTY

- A. Furnish 10 year limited warranty for panels, doors, and stiles against breakage, corrosion, delamination, and defects in factory workmanship.
- B. Furnish one-year guarantee against defects in material and workmanship for stainless steel door hardware and mounting brackets.

### **PART 2 PRODUCTS**

#### 2.1 PRODUCT AND MANUFACTURER

- A. Subject to compliance with requirements, provide "1182 Duraline Series" floor supported – overhead braced compartments" at both toilet compartments and shower compartments, and "1185 Duraline Series" wall mounted urinal screen units produced by Bobrick Washroom Equipment, or equivalent by Sanymetal, Accurate Partitions, Global Steel Products, Ampco, or Tex Lam Mfg., Inc.

#### 2.2 COMPONENTS / MATERIALS

- A. Stiles, Panels, Doors, and Screens:
  - 1. Solid phenolic material with high-pressure matte finish melamine surfaces fused to core. Edges shall be black. Solid phenolic material shall meet National Fire Protection Association Class A, Uniform Building Code Class I, ASTM E-84 Fire Resistance Standards; flame spread 20, smoke density 95. Brown edges shall not be acceptable.

Color and pattern as selected by Architect from full range of available standard colors.

2. Finish Thickness:
  - a. Stiles and doors shall be 3/4-inch (19-mm) thick.
  - b. Panels and benches shall be 1/2-inch (13-mm) thick.
- B. Hardware, General:
  1. All hardware to be 18-8, type 304 stainless steel with satin finish.
  2. All hardware shall be concealed inside compartments with the exception of outswinging doors.
  3. Hardware of chrome plated "Zamac" is unacceptable.
- C. Latch:
  1. Sliding door latch shall be 16-gauge (1.6mm).
  2. Sliding door latch shall require less than 5-lb force to operate. Twisting latch operation will not be acceptable.
  3. Latch track shall be attached to door by theft resistant one-way stainless steel machine screws into factory installed metal inserts. Fasteners secured directly into the core are not acceptable.
  4. Latch handle shall have rubber bumper to act as a doorstop.
  5. Latch shall allow door to be lifted over 11-gauge (3-mm) keeper for emergency access.
  6. Metal to metal connection shall withstand a direct pull of over 1000-lbs per screw.
- D. Hinges:
  1. Continuous stainless steel hinges shall be installed on the interior side of each door for the full height of the door. Provide wrap around hinge design where doors are required to swing out. No integral hinges are permitted.
  2. Hinges shall be attached to door and stile by theft resistant one-way stainless steel machine screws into factory installed metal inserts. Fasteners secured directly into the core are not acceptable.
  3. Metal to metal connection shall withstand a direct pull of over 1000-lbs per screw.
- E. Coat Hook: stainless steel coat hook shall project no more than 1-1/8-inch (29-mm) from face of door and shall be secured by theft resistant one-way stainless steel screws.
- F. Mounting Brackets: Stainless steel mounting brackets shall be mounted inside compartment. Mounting brackets exposed on the exterior of the compartment will not be acceptable. Wall mounted urinal screen brackets shall be 11-gauge (3mm) double thickness.
- G. Leveling Device: 3/8" x 1" (10 mm x 25 mm) steel bar shall be chromate treated and double zinc plated; bolted to base of solid phenolic stile.
- H. Stile Shoe: One piece, 4-inch (102-mm) high, type 304, 22-gauge (0.8 mm) stainless steel with satin finish. Top shall have 90° return to stile.
- I. Headrail (Overhead braced): Extruded anodized aluminum with satin finish.

### 2.3 FABRICATION

- A. Complete fabrication, assembly, finish hardware application, and other work before shipment to the Project Site to maximum extent possible.
- B. Take field measurements for work required to be fitted to other construction.
- C. Fabricate each pilaster, divider, end, door, and screen panel from one piece of solid phenolic plastic only. Bevel edges.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Verify that concealed blocking and substrates are properly prepared to receive compartments and screens. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Locate units and accessories where shown or scheduled, using mounting methods of type described and in compliance with manufacturer's instructions.

#### **3.2 INSTALLATION**

- A. Comply with manufacturer's instructions and mounting methods.
- B. Layout and install the work level, plumb and at height indicated and with clearances of not more than 1/2" between pilasters and partitions and not more than 1" at walls, free of scratches, dents, nicks, discolorations, and other defects in materials or workmanship.

#### **3.3 CLEANING AND PROTECTION**

- A. At completion of installation, promptly clean soiled surfaces in accordance with manufacturer's instructions.
- B. Protect units from damage until acceptance by Owner.

END OF SECTION

**10 28 00**

**TOILET ACCESSORIES**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes furnishing and installing toilet accessories at the locations indicated.

1.3 RELATED WORK

- A. Related Work of Other Sections:
  - 1. Section 09 20 00 – Gypsum Board And Light Gage Metal Framing.
  - 2. Section 09 30 00 – Tiling.
  - 3. Section 09 90 00 – Painting.
  - 4. Section 10 21 00 – Toilet Partitions.

1.4 SUBMITTALS

- A. Product Data: Submit product data for each type of unit required.
- B. Shop Drawings: Submit shop drawings for each type of unit required, including details of construction, finishes, fasteners, sizes and locations required.
  - 1. Show mounting locations and mounting heights.
  - 2. Show and relationship to framing, blocking, nailers and other related work.

1.5 PROJECT CONDITIONS

- A. Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting.
- B. Coordinate fabrication schedule with construction progress to avoid delay.

**PART 2 PRODUCTS**

2.1 PRODUCTS AND MANUFACTURERS

- A. Refer to toilet accessory schedule in drawings for basis of design manufacturers and products. Subject to compliance with the Design/Performance and other requirements, equivalent systems by other manufacturers will be acceptable as approved by the architect.
- B. Provide toilet accessories with brushed finish stainless steel except as noted.
- C. Coordinate accessory keying and other requirements with Owner's Representative.
  - 1. Include coordination of Owner Furnished items.

**PART 3 EXECUTION**

3.1 PREPARATION

- A. Verify that substrates, rough openings, and blocking are properly prepared to receive accessory units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Layout and securely install accessories and cabinets to supporting structure at locations indicated, level, plumb, at proper heights, and at margins indicated.
- B. Complete installation free of scratches, dents, nicks, discolorations, and other defects in materials or workmanship that cause accessory work to become unserviceable or objectionable in appearance.

3.3 CLEANING AND PROTECTION

- A. At completion of the installation, remove protective coverings and clean soiled accessory unit surfaces in accordance with the manufacturer's instructions.
- B. Protect units from damage until acceptance by Owner.

END OF SECTION

**10 51 13**

**METAL ATHLETIC LOCKERS**

**PART 1 GENERAL**

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes furnishing and installing:
  - 1. Heavy Duty Ventilated (HDV) Metal Lockers.
  - 2. Locker Room Benches

1.3 RELATED WORK

- A. Related Work of Other Sections:
  - 1. Section 02 00 00 – Existing Conditions
  - 2. Section 04 22 00 – Concrete Masonry Units
  - 3. Section 06 10 00 – Rough Carpentry
  - 4. Section 06 20 00 – Finish Carpentry

1.4 SUBMITTALS

- A. Product Data: Submit product data for each type of unit required.
- B. Shop Drawings: Submit shop drawings for each type of unit required, including details of construction, finishes, fasteners, sizes and locations required.
  - 1. Show and relationship to framing, blocking, nailers and other related work.
- C. Color Charts: Provide hard-copy original color charts showing manufacturer's available colors for architect's review. Provide metal samples if requested for further color verification.
- D. Numbering: Submit proposed locker numbering based on continuation of existing locker numbers.

1.5 QUALITY ASSURANCE

- A. MANUFACTURING STANDARD: Provide metal lockers that are standard products of a single manufacturer, with interchangeable like parts. Include necessary mounting accessories, fittings, and fastenings.
- B. FABRICATOR QUALIFICATIONS: Firm experience (minimum 5 years) in successfully producing the type of metal lockers indicated for this project, with sufficient production capacity to produce required units without causing delay in the work.
- C. INSTALLER QUALIFICATIONS: Engage an experienced (minimum 2 years) installer who has successfully completed installation of the type of metal lockers and extent to that indicated for this project.

## 1.6 PROJECT CONDITIONS

- A. Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting.
- B. Coordinate fabrication schedule with construction progress to avoid delay.

## 1.7 PRODUCT HANDLING

- A. **GENERAL:** All work shall be fabricated in ample time so as to not delay construction process.
- B. **DELIVERY:** All materials shall be delivered to the site at such a time as required for proper coordination of the work. Materials are to be received in the manufacturer's original, unopened packages and shall bear the manufacturer's label.
- C. **STORAGE:** Store all materials in a dry and well ventilated place adequately protected from the elements.

## 1.8 WARRANTY

- A. Knock-Down Lockers are covered against all defects in materials and workmanship excluding finish, damage resulting from deliberate destruction and vandalism under this section for a period of 2 years.
- B. Knock-Down Lockers are covered against all defects in installation for a period of one year.

## **PART 2 PRODUCTS**

### 2.1 PRODUCTS AND MANUFACTURERS

- A. **Manufacturers:** Basis of design for project is HDV (Heavy Duty Ventilated) Lockers and Wood Benches by Superior Lockers, List Industries, Inc. Other acceptable manufacturers include:
  - 1. ASI Storage Solutions.
  - 2. Hadrian
  - 3. Art Metal Products Inc.
  - 4. Republic Storage Solutions
- B. **General:**
  - 1. Provide and install two types of Heavy-Duty Ventilated Athletic lockers
    - a. Type: I: Wardrobe Lockers, Single Tier Units
      - 1) Size: 12" wide x 12" deep x 72" high
      - 2) 5% of Type I lockers (no fewer than one) accessible.
    - b. Type: II: Box Lockers, Six Tier Units
      - 1) Size: Size: 12" wide x 12" deep x 12" high
      - 2) 5% of Type II lockers (no fewer than one) accessible.
  - 2. Provide and install locker room benches of sizes and at locations indicated in drawings.
- C. **HEAVY-DUTY VENTILATED HDV LOCKERS:**
  - 1. Wardrobe Doors: 14 gauge perforated sheet steel with recessed handle, and multi-point gravity lift-type latching
  - 2. Box Doors: 14 gauge perforated sheet steel, side hinged with single-point friction catch finger-pull latching
  - 3. Sides: 16 gauge diamond perforated sheet steel.

4. Tops, Bottoms, Shelves: 16 gauge solid sheet steel
5. Backs: 18 gauge solid sheet steel

D. WOOD BENCHES

1. Standard Benches:
  - a. Bench Tops: Wood, minimum 9 ½" wide by 1 ¼" thick, with rounded corners and edges, in manufacturer's standard lengths as indicated in drawings.
    - 1) Material and finish: Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.
  - b. Pedestals: Manufacturer's standard pedestal supports, with predrilled fastener holes, complete with fasteners and anchors.
    - 1) Heavy Duty Steel (14 ga tube steel with 11 ga formed flanges).
    - 2) two per bench if top is 8' or less; three per bench if top is 9'-12".
    - 3) Color from manufacturer's standard range.
2. Accessible Benches
  - a. Bench Tops: Wood, minimum 20" minimum to 24" maximum wide by 42" minimum to 48" maximum long by 1 ¼" thick, with rounded corners and edges.
    - 1) Material and finish: Laminated maple with one coat of clear sealer on all surfaces, and one coat of clear lacquer on top and sides.
  - b. Pedestals: Height-Adjustable pedestal supports capable of required 18" bench height, with predrilled fastener holes, complete with fasteners and anchors.
    - 1) Four per bench.
    - 2) Color from manufacturer's standard range.
  - c.

2.2 FABRICATION

A. MATERIALS:

1. Steel Sheet: All sheet steel used in fabrication shall be prime grade free from scale and imperfections and capable of taking a heavy coat of custom blend powder coat.
2. Fasteners: Cadmium, zinc or nickel plated steel; bolt heads, slotless type; self locking nuts or lock washers.
3. Hardware: Hooks and hang rods of cadmium plated or zinc plated steel or cast aluminum.
4. Handle: Seamless drawn 304 stainless steel recessed handle.
5. Number Plates: To be aluminum with not less than 3/8" high etched numbers attached to door with two aluminum rivets.

B. CONSTRUCTION: Fabricate lockers square, rigid and without warp, with metal faces flat and free from dents or distortion. Make all exposed metal edges safe to touch. Weld frame members together to form a rigid, one-piece structure. Weld, bolt or rivet other joints and connections as is standard with manufacturer. Grind exposed welds flush. Do not expose bolts or rivet heads on front of locker doors or frames except for fastening of number plates and recessed handle.

1. FRAME: Fabricate of 16 gauge (minimum) channels, with integral continuous door stop/strike formed on both latch and hinge side vertical members. Cross frame members of 16 gauge channel shapes, including intermediate cross frame members on double and triple tier (frames with doors over 18" high) lockers shall be securely welded to the vertical framing members to ensure rigidity. Rubber bumpers shall be provided to cushion door closing.
2. HAT SHELVES, INTERMEDIATE SHELVES AND BOTTOMS: Shall be formed with 16 gauge (minimum) solid sheet steel with single return bends at all sides. Bolt top and bottom as well as horizontal tier dividers of wardrobe openings to front horizontal frame members at not less than one place in addition to side panels. Form hat shelves at 60" and 72" high single tier lockers of 16 gauge (minimum) sheet steel with

- single bends at sides and back and a double bend at front.
3. BACKS: Shall be 18 gauge (minimum) cold rolled sheet steel with double flanged connections extending full height.
  4. WARDROBE DOORS: Doors 20" high and higher shall be fabricated from single sheet prime 14 gauge with single bends at top and bottom and double bends at the sides. The channel formed by the double bend at the latch side is designed to fully conceal the lock bar. Doors to be perforated with 5/8" x 1-1/2" diamonds.
  5. LATCHING: Shall be finger lift control type constructed of 14 gauge (minimum) steel with a nylon cover that has a generous finger pull. Spring activated nylon slide latches shall be completely enclosed in the lock channel allowing doors to close with the lock in the locked position. Locking device shall be designed for use with either built-in combination locks or padlocks. Provide three latch hooks for doors 48" and over and two for doors under 48".
  6. HANDLE: All wardrobe locker doors shall have a seamless drawn 304 stainless steel recessed handle shaped to receive a padlock or built-in combination lock. The recess pan shall be deep enough to have the lock be completely flush with the outer door face. A finger lift/padlock shall protrude through the top of the handle for easy opening of the locker door.
  7. BOX DOORS: Doors 18" high and under to be fabricated from single sheet prime 14 gauge with single bends at top, bottom and sides. Doors shall include a combination friction catch door pull. Padlock Strike Plates are optional. Doors shall be fabricated to accept a built-in combination lock or padlock. Doors with projecting spring latches shall not be acceptable. Doors are to be perforated with 7/16" x 15/16" diamonds.
  8. DOOR HINGES: All doors shall include a 16 gauge continuous piano hinge welded to the door and riveted to the frame. All doors to be right hand, side hinged.

### 2.3 LOCKER ACCESSORIES:

#### A. LOCKS

1. Built-In Combination Locks (at locations indicated in drawings): Built-in combination automatic dead bolt locks with 5 control keys. Locks must be capable of a minimum of five combination changes.
2. Combination Padlocks (at all other locations): By Others.

#### B. EQUIPMENT: Furnish each locker with the following items, unless otherwise shown.

1. Single tier lockers: Openings 60" and 72" shall include one hat shelf, one double prong ceiling hook and a minimum of two single prong wall hooks.
2. Finished End Panels: Shall be "Boxed" type formed from 16 gauge cold rolled steel with 1" O.D. double bends on sides and a single bend at top and bottom with no exposed holes or bolts. If lockers have slope tops, end panels must be formed with slope at top to cover the ends of the slope tops. Finished to match lockers. Provide at all exposed ends.
  - a. Where existing CMU columns prevent installation of full-depth finished end panel, the panels may be cut to cover only the area exposed beyond the existing column.
3. Continuous Slope Tops: Not less than 18 gauge sheet steel approximately 18 degrees pitch, in lengths as long as practical but not less than four lockers. To be installed in addition to the locker flat top with end closures for support. Finished to match lockers.
4. Fillers: Provide at ends of locker-runs if short of existing adjacent column, of not less than 16 gauge sheet steel, factory fabricated and finished to match lockers.

#### C. FINISHING: All locker parts to be cleaned and coated after fabrication with a seven stage hot-spray washing process and coated with a zirconium-based nanotechnology providing a green alternative to traditional iron phosphate followed by a coat of high grade custom blend

powder electrostatically sprayed and baked at 350 degrees Fahrenheit for a minimum of 20 minutes to provide a tough durable finish. Color to be selected from manufacturer's standard list of colors. Body components shall be manufacturer's standard interior neutral. Two-Tone Color Combination: Shall be at no additional cost with the locker frame and trim chosen from one color and the doors may be one of any other color chosen from manufacturers standard selection.

### **PART 3 EXECUTION**

#### **3.1 PREPARATION**

- A. Verify that substrates, rough openings, and blocking are properly prepared to receive locker units. Do not proceed with installation until unsatisfactory conditions have been corrected.

#### **3.2 INSTALLATION**

#### **3.3 INSTALLATION**

- A. **GENERAL:** Installation shall be in strict conformance with referenced standards, the manufacturer's written directions, as shown on the drawings and as herein specified.
- B. **PLACEMENT:** Lockers shall be set in place, plumb, level, rigid, flush and securely attached to the wall (or bolted together if back-to-back) and anchored to the floor or base according to manufacturer's specifications.
- C. **ANCHORAGE:** About 48" O.C., unless otherwise recommended by manufacturer, and apply where necessary to avoid metal distortion, using concealed fasteners. Friction cups are not acceptable.
- D. **TRIM:** Sloping tops, metal fillers and end panels shall be installed using concealed fasteners. Provide flush, hairline joints against adjacent surfaces.

#### **3.4 ADJUSTMENT, CLEANING, AND PROTECTION**

- A. Upon completion of installation, inspect lockers and adjust as necessary for proper door operation.
- B. Remove protective coverings. Touch-up scratches and abrasions to match original finish. Clean soiled surfaces in accordance with the manufacturer's instructions.
- C. Protect units from damage until acceptance by Owner.

END OF SECTION

**22 00 00**

**GENERAL REQUIREMENTS FOR PLUMBING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Coordinate with Commissioning Requirements indicated in Section 019100. This Contractor is responsible to comply with all requirements for the above section.

**1.2 SUMMARY**

- A. Design a complete plumbing system including all sanitary, waste and vent piping, storm piping, gas piping and all equipment necessary for a complete system and in accordance with all local jurisdictions and codes.
- B. A record shall be kept of all permits and inspections and submitted to the Master Plumber. In addition, a list of all equipment and devices will be provided.
- C. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. Equipment installation requirements common to equipment sections.
  - 9. Painting and finishing.
  - 10. Concrete bases.
  - 11. Supports and anchorages.

**1.3 DEFINITIONS**

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

- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. ABS: Acrylonitrile-butadiene-styrene plastic.
  - 2. CPVC: Chlorinated polyvinyl chloride plastic.
  - 3. PE: Polyethylene plastic.
  - 4. PVC: Polyvinyl chloride plastic.
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: Include Products specified in the following Sections:
  - 1. Section 22 00 00 – General Requirements for Plumbing
  - 2. Section 22 05 16 – Expansion Fittings and Loops for Plumbing Piping
  - 3. Section 22 05 23 – General Duty Valves for Plumbing Piping
  - 4. Section 22 05 29 – Hangers and Supports for Plumbing Piping
  - 5. Section 22 05 53 – Identification for Plumbing Piping & Equipment
  - 6. Section 22 07 00 – Plumbing Insulation
  - 7. Section 22 08 00 – Commissioning of Plumbing Systems
  - 8. Section 22 11 16 – Domestic Water Piping
  - 9. Section 22 11 19 – Domestic Water Piping Specialties
  - 10. Section 22 11 23 – Domestic Water Pumps
  - 11. Section 22 13 16 – Sanitary Waste Piping
  - 12. Section 22 13 19 – Sanitary Waste Piping Specialties
  - 13. Section 22 14 13 – Facility Storm Water Piping
  - 14. Section 22 20 00 – Natural Gas Piping
  - 15. Section 22 32 00 – Domestic Water Filtration Equipment
  - 16. Section 22 33 00 – Electric Domestic Water Heaters
  - 17. Section 22 40 00 – Plumbing Fixtures
  - 18. Section 22 47 00 – Drinking Fountains and Water Coolers
- A. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- B. Mark dimensions and values in units to match those specified.
- C. 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.
- D. 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 (1) print with comments.

## 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
  - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for Plumbing Equipment: All materials and distribution, and utilization equipment shall be UL Listed. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## 1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Prepare Coordination / Installation Shop drawings to a scale of 1/4"=1'-0" or larger; detailing major elements, components, and systems of plumbing equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
  - 1. Structural floor, wall and roof opening sizes and details
  - 2. Clearances for installing and maintaining insulation.
  - 3. Locations of light fixtures and sprinkler heads.
  - 4. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
  - 5. Equipment connections and support details.
  - 6. Exterior wall and foundation penetrations.
  - 7. Routing of piping.
  - 8. Fire rated wall and floor penetrations.
  - 9. Sizes and location of required concrete pads and bases.

10. Valve stem movement.

### **1.8 APPLICABLE CODES**

- A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.
- B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.
- C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:
  1. Underwriters' Laboratories, Inc., UL.
  2. American Standards Association, ASA.
  3. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
  4. American Society of Mechanical Engineers, ASME.
  5. American Society of Plumbing Engineers, ASPE.
  6. American Society of Testing Materials, ASTM.
  7. American Water Works Association, AWWA.
  8. International Plumbing and Fuel Gas Codes, 2015 edition with City of Stafford, Texas amendments.
  9. National Bureau of Standards, NBS.
  10. NFPA 70, National Electrical Code, 2017 edition with City of Stafford, Texas amendments.
  11. Texas Accessibility Standards (TAS) - Elimination of Architectural Barriers, Texas Government Code, Chapter 469 administered by the Texas Department of Licensing and Regulation (TDLR), effective March 15, 2012.
- D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.
- E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

### **1.9 DRAWINGS AND SPECIFICATIONS**

- A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.
- B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least seven (7) working days prior to bid opening date for issuance of an addendum.

- C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.
- D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.
- E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing ten (10) days prior to the bid date without fail.
- F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.
- G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.
- H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outline herein. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) and Plumbing Design Documents and all other trades.
- I. Coordinate with Division 01 requirements for substitution, unless noted otherwise the Contractors wishing to substitute products, materials or methods from those indicated or specified, shall submit such requests to the Owner or Engineer in writing and within THIRTY (30) WORKING DAYS OF NOTIFICATION OF CONTRACT AWARD. Requests for permission to utilize alternates or substitutions will not be considered after that time, unless the Specified item is unavailable or will adversely affect completion of the Project. Claims submitted for consideration will require notarized letters from all parties involved and will be considered only if the Contractor has been timely in his delivery for review of all required equipment and material submittals. Owner or Engineer will investigate such requests for substitution and if acceptable will issue a letter allowing the substitution.
- J. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.

- K. Requests shall be bound and shall consist of three (3) sets of descriptive literature and performance data covering each item of equipment or material. The submittal shall include the following:
1. Manufacturer's name and phone number
  2. Name of the person submitting the product
  3. Model number
  4. Performance
  5. Statement of compliance with specification.
  6. Name of the individuals or company originating the submittal.
  7. Name of the project for which the submittal is made.
  8. An index page of the items submitted.
  9. A written list of variations between the specified product and the submitted product.
  10. Sufficient information, including scaled drawing of area and equipment involved at a scale of 1/4" = 1'-0" minimum, as required to demonstrate that the alternate or substituted product will fit in the space available.
  11. Identification of each item of material or equipment matching that indicated on the Drawings. All applicable industry or national Listings, Labels, Approvals and Standards shall be clearly indicated.
  12. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements shall be so indicated. All non-applicable information shall be crossed out.
  13. Provide upon request of the Owner or Engineer, samples of materials and/or equipment as may be required.
- L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a letter allowing the substitutions. The Engineer shall be the sole authority to approve or disapprove any and all substitutions.
- M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades and pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

#### **1.10 RECORD DOCUMENTS**

- A. Prepare record documents in accordance with the requirements in Special Project Requirements, in addition to the requirements specified in Division 22, indicate the following installed conditions.
1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
  2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
  3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
  5. Contract Modifications, actual equipment and materials installed.

- B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.
- C. Contractor Startup and Commissioning Verification - the system will provide a secure page for each integrated system allowing the contractor responsible for each phase to sign on and certify the status of each piece of equipment.
- D. Refer to Division 01 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as built prints and re-producible is a condition of final acceptance.
- E. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.
- F. At the Engineer's option, the Contractor shall transfer all data from the record "AS-BUILT" prints to an electronic media such as AutoCAD latest release, in order to plot the reproducible media "AS-BUILT" drawings. Since data stored on electronic media can deteriorate undetected or be modified without the Engineer's knowledge, the AutoCAD electronic drawing files are provided without warranty or obligation on the part of the Engineer as to accuracy or information contained in the files. All information in the files shall be independently verified by the user. Any user shall agree to indemnify and hold the Engineer harmless from any and all claims, damages, losses, and expenses including but not limited to Attorney's fees arising out of the use of the AutoCAD drawing files. Engineer shall furnish to the Contractor electronic media files of Contract Documents for the Contractor to use for inputting of the data from the record "AS-BUILT" prints and the Contractor shall return the revised electronic files on CD ROM properly labeled to the Engineer and shall submit the plotted reproducible drawings and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as described in paragraph G. below.
- G. Contractor shall transfer all marks from record drawings and submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of blackline prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineer's Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

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

## 2.2 PIPE, TUBE, AND FITTINGS

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

## 2.3 JOINING MATERIALS

- A. Refer to individual Division 22 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
    - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
    - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
  - 1. Solvent Cements for Joining Plastic Piping:
  - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

## 2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Dresser Industries, Inc.; DMD Div.
    - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
    - d. JCM Industries.
    - e. Smith-Blair, Inc.
    - f. Viking Johnson.
  - 2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
  - 3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
  - 4. Aboveground Pressure Piping: Pipe fitting.
  - 5. Manufacturers:
    - a. Eslon Thermoplastics.

- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
  - 1. Manufacturers:
    - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC PVC CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
  - 1. Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.
- D. Flexible Transition Couplings for Underground Non-pressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Fernco, Inc.
    - c. Mission Rubber Company.
    - d. Plastic Oddities, Inc.

## 2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F
- D. Coordinate subparagraph and associated subparagraphs below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. Epco Sales, Inc.
    - e. Hart Industries, International, Inc.
    - f. Watts Industries, Inc.; Water Products Div.
    - g. Zurn Industries, Inc.; Wilkins Div.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
  - 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- F. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  - 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.

- c. Central Plastics Company.
  - d. Pipeline Seal and Insulator, Inc.
- 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
  
- G. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F
  - 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
  
- H. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
  - 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

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

## 2.7 SLEEVES

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

## 2.8 ESCUTCHEONS

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

## 2.9 GROUT

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

## PART 3 - EXECUTION

### 3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. All cleanouts shall be accessible.
- D. Any room that has a plumbing fixture shall have an accessible isolation valve.
- E. Provide hot and cold and tempered water isolation valves at every supply pipe to each restroom or restroom bank. Isolation valves shall be accessible in all restrooms. The Contractor shall provide a minimum of 2 feet accessible pipe chase for maintenance. For restrooms with hard ceilings, provide a 24"x24" access panel effectively positioned at "wet" wall for maintenance and inspection purposes.

- F. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- I. Install piping to permit valve servicing.
- J. Install piping at indicated slopes.
- K. Install piping free of sags and bends.
- L. Install fittings for changes in direction and branch connections.
- M. Install piping to allow application of insulation.
- N. Select system components with pressure rating equal to or greater than system operating pressure.
- O. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  - 1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
    - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - g. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
    - h. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
    - i. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
    - j. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- P. Sleeves are not required for core-drilled holes.
- Q. Permanent sleeves are not required for holes formed by removable PE sleeves.
- R. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- S. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
  - 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
      - 1) Seal space outside of sleeve fittings with grout.
  4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- T. Water and gas lines under drives and walkways shall be sleeved with schedule to PVC, at least two (2) pipe sizes larger than the supply line.
- U. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- V. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- W. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire stop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- X. Verify final equipment locations for roughing-in.
- Y. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.
- Z. Coordinate setting of equipment with the requirements of other trades so as to avoid conflicts and to insure compatibility. Equipment shall not block access for installation of other equipment.
- AA. Set base mounted equipment on permanent and finished supports. Temporary support, if any, shall be removed prior to making final pipe, duct, or electrical connections to equipment.

- BB. Adjust suspended equipment to final elevation prior to making pipe, duct or electrical connections.
- CC. Exercise caution during equipment placing operations to ensure that structure is not overloaded.
- DD. Do not move heavy equipment across floor or roof of insufficient load bearing capacity to support such equipment. Provide bracing or shoring as required or use crane to place equipment directly on permanent and finished support.
- EE. Secure all roof mounted equipment to the structure adequately to resist overturning, uplift and sliding forces for the following wind design criteria:
  - 1. Ultimate Wind Speed: 147mph, 3-second gust.
  - 2. Exposure: B.
  - 3. Risk Category: III.

### **3.2 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints:
  - 1. Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
  - 2. All necessary precautions shall be taken as required to prevent damage to the roofing due to welding or cutting of pipe. Any damage shall be repaired by the roofing contractor, payment of which will be made by the responsible party. Extent and nature of repairs necessary will be as approved by Stafford MSD Construction Services Division.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
  - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.

2. PVC Non-pressure Piping: Join according to ASTM D2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D3212.

### **3.3 PIPING CONNECTIONS**

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

### **3.5 PAINTING**

- A. Painting of plumbing systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.6 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
  1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

### **3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Wood supports are not allowed.

### **3.9 GROUTING**

- A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION 22 00 00**

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**GENERAL DUTY VALVES FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 SECTION INCLUDES**

- A. Valves for building plumbing service piping.

**1.2 REFERENCES**

- A. AGA Z21.22 - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.
- B. AWS - Welding and Brazing Qualifications.
- C. MSS SP-67 - Butterfly Valves.
- D. MSS SP-71 - Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- E. MSS SP-80 - Bronze Gate, Globe, Angle and Check Valves.
- F. MSS SP-85 - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.
- G. MSS SP-110 - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

**1.3 SUBMITTALS**

- A. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.
- B. Welders Certificate: Include welder's certification of compliance with ASME SEC IX.
- C. Manufacturer's Installation Instructions: Submit hanging and support methods, joining procedures.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

**1.4 CLOSEOUT SUBMITTALS**

- A. Project Record Documents: Record actual locations of valves.
- B. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

**1.5 QUALITY ASSURANCE**

- A. Perform Work in accordance with State of Texas and authority having jurisdiction codes and standards.
- B. Maintain one (1) copy of each document on site.

- C. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.
- D. Welding Materials and Procedures: Conform to ASME SEC 9.
- E. Conform to ASME B31.1.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- B. Provide temporary protective coating on cast iron and steel valves.

#### **1.7 ENVIRONMENTAL REQUIREMENTS**

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

#### **1.8 WARRANTY**

- A. Provide five-year manufacturer warranty for valves excluding packing.

#### **1.9 EXTRA MATERIALS**

- A. Supply two (2) packing kits for each size valve.
- B. Provide one (1) master flow meter for this project, to become the property of the Owner.
- C. Provide a hand-held, portable meter which instantaneously displays flow and/or changes in flow by means of a high-visibility, integral, backlit LCD that displays flow rate in GPM. Charts and tables are not allowed.

### **PART 2 - PRODUCTS**

#### **2.1 VALVES**

- A. Manufacturers
  - 1. Ball and Butterfly Valves
    - a. Keystone
    - b. Milwaukee
    - c. Nibco
  - 2. Butterfly Valves
    - a. Keystone
    - b. Nibco
  - 3. Check Valves
    - a. Nibco
    - b. Watts
- B. General
  - 1. Provide valves of same manufacturer throughout the project where possible.
  - 2. Provide valves with manufacturer's name and pressure rating clearly marked on outside of body.
  - 3. Valve Connections

- a. Provide valves suitable to connect to adjoining piping as specified for pipe joints. Use line pipe size valves.
  - b. Threaded pipe sizes 2 inches and smaller.
  - c. Flange pipe sizes over 2 inches.
  - d. Solder or screw to solder adapters for copper tubing.
  - e. Use grooved coupling for grooved end pipe.
4. Check Valves
- a. 2 Inches and Smaller: Spring loaded in-line check valve; Nibco 480 series, or Watts 600 series.
  - b. Over 2 Inches: Iron body, bronze trim, swing disc, renewable disc and seat, flanged ends; Nibco F-908 series or Watts 410 series
  - c. Discharge of Pumps: 150 psi W.O.G., iron body, replaceable bronze disc and seat, globe disc design, 316 S.S. spring, flange connections.
- C. Butterfly valves (4" and larger only) must be full-lug body type. Valves 4" through 12" must be rated for 200 psi at 175 degrees F.; valves 14" through 36" must be rated for 150 psi at 200 degrees F. Valves must meet ANSI Class 125/150 flange standards and MSS SP-67 standards.
1. Valve body construction must be ductile iron.
  2. Seat must be dovetail, or tongue-in-groove, EPDM seat designed to ensure bubble-tight, bi-directional shutoff and must be field replaceable. Seat must be designed to fully isolate the valve body, stem and journal areas from the flowing media. Buna-N seat must be used for thermal storage and glycol systems.
  3. Disc/Stem - The valve must have a one-piece disc/stem assembly or other positive mechanical engagement design for minimum obstruction to flow. Use of pins or bolts exposed in the waterway to attach disc to stem are not allowed. Material for disc and stem must be 316 stainless steel. The disc edges and hubs must be hand polished to a 32 AARH or better finish.
  4. Inboard Bearings/Upper Steam Busing/Stem Packing - The valve must have upper and lower inboard stem bearings isolated from the line media, a heavy duty upper stem bushing, and bi-directional stem packing to ensure dry stem design.
  5. Operator must have an integral cast top plate for direct flush-mounting of manual operator or actuator without use of brackets or adapters. Provide 4" and 6" valves with lever-lock type operator. Provide valves 8" and larger with manual gear operators.
- D. Drain Valves: Bronze compression stop with nipple and cap or hose thread.
1. Pressure Ratings: Unless otherwise indicated, use valves suitable for 125 minimum psig WSP at 450 degrees F and maximum 200 psig at 250 degrees F.
- E. Ball Valves:
1. 2 Inches and Smaller: Bronze body, full port, 316 S.S. ball and stem, reinforced Teflon seats, separate packnut with adjustable stem packing, 600 psi W.O.G., solder or threaded ends. Valve ends must have full depth ANSI threads or extended solder connections and conform to MSS SP-110. Provide with balancing stops and non-metallic stem extensions for pipe insulation.
  2. Over 2 Inches: Carbon steel body, 316 S.S. ball and stem. Teflon seat and stuffing box seal, conventional bore, Class 150 and conforming to MSS SP-72, lever handle, flanged ends, and balancing stops.
  3. All ball valves for fuel gas service shall be AGA or U.L. and City of Houston approved. Milwaukee Butterball valves are acceptable.
- F. Manual Valve Operators
1. Provide suitable handwheels for gate, ball and drain valves.
  2. For butterfly valves provide gear operators for sizes 8 inches and larger. For smaller sizes, provide lever lock handle with toothed plate for shut-off service and infinitely adjustable handle with lock nut and memory stop for throttling service.

3. Provide valves located more than 6 feet from floor in equipment room areas with chain wheel operators. Extend chains to approximately 5 feet above floor and provide hook type tie back clips arranged to retain chain clear of walking aisles.
- G. Pressure Reducing/Pressure Sustaining Valve:
1. 400 psi W.O.G., bronze body, globe design, bolted bonnet, bronze pilot control, S.S. trim, Buna N disc. Provide with solenoid control, solenoid by-pass cock, flow clean strainer, isolation valve, check valve with cock, position transmitter, independent operating pressure, atmospheric drain, electronic controller, CV flow controls and Y-strainer.
  2. The valve controller shall provide the interface between a remote computer system and the control valve. The controlled parameter signal shall be accepted through a 4-20 mA feedback signal. Local manual set point control and full manual control of control valve solenoids is to be provided on the controller panel for local control.
  3. Upon receiving the set point command signal from the remote computer system, the controller will signal the valve to move and maintain the valve at the desired set point. A vacuum fluorescent display of current status and set-point value in scalable engineering units shall be supplied.
  4. The controller shall compare set-point and feedback values and adjust the valve accordingly to achieve the set-point. When the feedback signal deviates from the set-point value, the appropriate opening or closing solenoid on the control valve shall activate. As the feedback signal approaches the set-point, the solenoid output will pulse on and off to gradually return the measurement to set-point. One solid state relay energizes for measurements condition below the set-point while the other energizes for measurement greater than set-point. These outputs shall be wired direct or through intermediate relays to the opening and closing solenoids on the control valve. Solenoid output indicator lights shall illuminate when either the open or closed solenoid is activated.
  5. The total cycle time between each pulse shall be programmable between 1 and 60 seconds. The duration of each pulse shall be directly proportional to the deviation from set-point outside of dead band. The time proportioned outputs shall be independently adjustable for conditions above and below the set-points to properly tune valve response. The time proportional output band width shall be independently programmable between 1 and 200 percent of full scale. When the feedback signal returns within the deadband zone, the valve will maintain position. Provision shall be made to open/close/maintain position in the event of a loss of the feedback signal.
  6. The operator interface shall consist of two rows of alphanumeric characters to display numeric values and units. Color coded alarm, status and mode indicators shall inform the operator of operating conditions. Security key codes shall protect against undesired changes to the controller. All programming shall include keywords and prompts to aid in setup and tuning the controller.
  7. The controller shall be all solid state construction with the internal chassis capable of being removed for inspection and adjustment. All program memory including set-point and tuning parameters shall be protected by an internal lithium battery rated for ten (10) year life.
  8. Remote communications shall be accepted through a 4-20 mA DC analog set-point signal. The controller shall monitor the set-point signal. When local control is selected, the set-point shall be changed at the controller keypad.
  9. The controller shall be capable of direct linkage to a computer or other instrumentation, which has RS-232C or RS-422 communications. When RS-422 data highway communications is specified, up to 64 controllers may be addressed from a single computer port and shall operate up to 5,000 feet from the computer, RS-232C shall operate up to 50' distance between the computer or TRU and the valve controller. All set-point, tuning, and auto-manual operation shall be adjustable remotely from the computer. All commands shall consist of ASCII mnemonic commands sent from the computer. Each transmission shall include the individual controller address. Communication baud rates shall be 300, 1,200, or 2,400 baud.

10. The Electronic Valve Controller shall be the Cla-Val Model 131 VC Valve Controller as manufactured by Cla-Val, Co. or approved equal.

## **2.2 AIR VENTS**

- A. Manufacturers:
  1. Bell and Gossett.
  2. Taco.
  3. Watts.
  4. Armstrong.
- B. Manual Type: Short vertical sections of 2 inch diameter pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- C. Float Type: Brass, cast iron or semi-steel body, copper or stainless steel float, stainless steel valve and valve seat; suitable for system operating temperature and pressure (minimum 125 psig); with isolating valve.

## **2.3 STRAINERS**

- A. Manufacturers:
  1. Keckley.
  2. Mueller.
  3. Strainers, Inc.
  4. Victaulic.
  5. Grinnell.
- B. 2 Inches and Smaller: Screwed brass or iron body for 150 psig working pressure, Y pattern with 1/32-inch stainless steel perforated screen.
- C. 2-1/2 Inches to 4 Inches: Flanged iron body for 150 psig working pressure, Y pattern with 3/64-inch stainless steel perforated screen.
- D. Over 4 Inches: Flanged iron body for 150 psig working pressure, basket pattern with 1/8-inch stainless steel perforated screen.
- E. Provide grooved couplings for grooved end pipe.

## **2.4 RELIEF VALVES**

- A. Manufacturers:
  1. Bell and Gossett.
  2. Taco.
  3. Watts.
  4. Armstrong.
- B. Bronze body, Teflon seat, stainless steel stem and springs, minimum 3/4", automatic, direct pressure actuated, capacities ASME certified and labeled, set at factory for 45 psig, unless otherwise required by system.
- C.

## **2.5 PRESSURE REDUCING VALVES**

- A. Manufacturers:

1. Bell and Gossett.
2. Taco.
3. Watts.
4. Armstrong.

- B. Bronze body, removable cartridge seat assembly, bronze internal parts; with built-in strainer, built-in back pressure check valve and adjustable filling valve pressure. Valves shall be minimum 3/4" and factory set for 25 psi.

### **PART 3 - EXECUTION**

#### **3.1 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.

#### **3.2 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 with pipe rollers, guides, anchors, and expansion loops as required to allow for expansion and contraction without stressing pipe, joints, or connected equipment; refer to Section 22 05 16.
- E. Provide clearance for installation of insulation, and access to valves and fittings.
- F. Provide access where valves and fittings are not exposed.
- G. Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- H. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- I. Prepare pipe, fittings, supports, and accessories for primer coat painting prior to insulation; refer to Section 22 07 00. Prepare pipe, fittings, supports, and accessories for primer coat, undercoat, and finish coat painting for all uninsulated piping; refer to Section 22 11 16.
- J. Use grooved mechanical couplings and fasteners only in equipment rooms.
- K. Install unions downstream of valves and at equipment or apparatus connections.
- L. Install brass male adapters each side of valves in copper piped system. Sweat solders adapters to pipe.

- M. Water supply valves:
  - 1. 1/4" to 2" size: ball valves.
  - 2. 2-1/2" and larger: ball or butterfly valves (butterfly valves shall be lug style only)
- N. Provide isolation valves in main domestic water lines in building to isolate sections of the building.
- O. Provide isolation valves at each fixture group.
- P. Locate valves over accessible areas as practical. Coordinate location with architectural features so that the valves are operable and accessible.
- Q. When located above ceiling, provide easy access to horizontal stem. Locate valves within 18" of ceiling so that they are within reach.
- R. Coordinate with Owner an acceptable way of subtly marking the location of valves, such as a thumbtack on an acoustical ceiling tile.
- S. Provide 3/4-inch ball drain valves at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest drain.
- T. Install pre-insulated underground pipe in total compliance with the manufacturer's recommendations. Provide pipe casing and sleeves at slab-on-grade penetrations in total compliance with Section 22 05 29 (No Exceptions).
- U. Test piping in compliance with the requirements of Division 1 and Section 22 11 16.
- V. Install specialties in accordance with manufacturer's instructions to permit intended performance.
- W. Provide manual air vents at system high points readily accessible.
- X. Provide automatic air vents in ceiling spaces or other high or concealed locations, provide vent tubing to nearest drain.
- Y. Provide valved drain and hose connection on strainer blow down connection.
- Z. Provide a relief valve on discharge side of pumps.
- AA. Select system relief valve capacity so that it is greater than system operating pressure.
- BB. Pipe relief valve outlet to nearest floor drain.
- CC. Where one line vents several relief valves, make cross sectional area equal to sum of individual vent areas.
- DD. Provide pump suction fitting on suction side of base mounted centrifugal pumps where indicated. Remove temporary strainers after cleaning systems.
- EE. Support pump fittings with floor mounted pipe and flange supports.
- FF. Provide flow metering stations where indicated on the Drawings. Furnish the TAB Contractor with the flow meter to be used in performing his work. After completion of all TAB work, turn the flow meter over to the Owner's personnel for their use. Provide the Owner with a schematic drawing indicating the location of all flow metering stations and the design flow rate for each station. Instruct the Owner's personnel in the proper use of the flow metering equipment.

- GG. Provide thermometer and pressure gauges for all equipment and/or as shown on the drawings.
- HH. Insulate piping as required by Section 22 07 00.
- II. Pipe make-up line with pressure reducing and pressure relief valves to air separator fitting. Provide quick-fill/bypass line as shown on the drawings.
- JJ. Insulate equipment as per Section 22 07 00.
- KK. Label all valves with bronze punched data plate. Plate shall be a minimum of six inches diameter.

**END OF SECTION 22 05 23**

**22 05 29**

**HANGERS AND SUPPORTS FOR PLUMBING PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.
  - 4. Thermal-hanger shield inserts.
  - 5. Fastener systems.
  - 6. Pipe stands.
  - 7. Pipe positioning systems.
  - 8. Equipment supports.
- B. Related Sections include the following:
  - 1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
  - 2. Division 21 Section "Sprinklers Systems" for fire-suppression piping.

**1.3 DEFINITIONS**

- A. MSS: Manufacturers Standardization Society for "The Valve and Fittings Industry Inc".
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

**1.4 PERFORMANCE REQUIREMENTS**

- A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- C. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

**1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Mechanical expansion fastener systems.
  - 4. Pipe positioning systems.

- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
  - 1. Trapeze pipe hangers. Include Product Data for components.
  - 2. Metal framing systems. Include Product Data for components.
  - 3. Pipe stands. Include Product Data for components.
  - 4. Equipment supports.
- C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Welding: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1, "Structural Welding Code--Steel."
  - 2. ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Available Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. Carpenter & Paterson, Inc.
  - 3. Globe Pipe Hanger Products, Inc.
  - 4. Anvil International Corp.
- C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.
- D. Nonmetallic Coatings: Plastic coating, jacket, or liner.
- E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

### 2.2 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

### 2.3 METAL FRAMING SYSTEMS

- A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.
- B. Acceptable Manufacturers:
  - 1. B-Line Systems, Inc.; a division of Cooper Industries.
  - 2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
  - 3. GS Metals Corp.
  - 4. Power-Strut Div.; Tyco International, Ltd.
  - 5. Thomas & Betts Corporation.
  - 6. Tolco Inc.

7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

## 2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig-minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Acceptable Manufacturers:

1. Engineered Products, Inc.
2. Insulation Carpenter & Paterson, Inc.
3. ERICO/Michigan Hanger Co.
4. PHS Industries, Inc.
5. Pipe Shields, Inc.
6. Rilco Manufacturing Company, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated stainless steel, for use in hardened Portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Acceptable Manufacturers:
  - a. B-Line Systems, Inc.; a division of Cooper Industries.
  - b. Empire Industries, Inc.
  - c. Hilti, Inc.
  - d. ITW Ramset/Red Head.
  - e. MKT Fastening, LLC.
  - f. Powers Fasteners.

## 2.6 PIPE STAND FABRICATION

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. All piping on roof shall be supported by roof mounted pipe supports. **No wood is allowed.**

C. All Pipe support system on roof shall be sized / designed by manufacturer and installed by this Contractor. The pipe support system shall be suitable for the insulated chilled water and hot

water piping system as indicated on drawings. Pipe support system must meet the following requirements:

1. Bottom of the pipe must be 18" above roof finished level.
  2. Pipe support spacing shall be based on the maximum roof load of 2.5 #/sq-inch. Contractor must size the pedestal base area for each support in coordination with the required support spacing such that the total load on roof does not exceed 2.5 #/sq-inch.
  3. Submit the proposed scheme to the engineer for approval before material procurement or installation of any work.
  4. Contractor is responsible to price all the support system at the project bid stage.
  5. Contractor is responsible to coordinate all the support system with the roofing drawings of this package.
  6. Provide expansion loops and floating support system in accordance with requirements.
  7. The support channels and plate frames indicated on the drawings are the required minimum standards. Support system vendor must verify the loads on each section and upgrade as necessary.
- D. Compact Pipe Stand: One-piece plastic unit with integral-rod-roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.
1. Acceptable Manufacturers:
    - a. ERICO/Michigan Hanger Co.
    - b. MIRO Industries.
    - c. PHP Systems
- E. Low-Type, Single-Pipe Stand: One-piece plastic base unit with plastic roller, for roof installation without membrane penetration.
1. Acceptable Manufacturers:
    - a. MIRO Industries (or equal).
    - b. PHP Systems
- F. High-Type, Single-Pipe Stand: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
1. Acceptable Manufacturers:
    - a. ERICO/Michigan Hanger Co.
    - b. MIRO Industries.
    - c. Portable Pipe Hangers.
  2. Base: Plastic.
  3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
  4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- G. High-Type, Multiple-Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
1. Acceptable Manufacturers:
    - a. Portable Pipe Hangers.
    - b. MIRO Industries.
    - c. Portable Pipe Hangers
  2. Bases: One or more plastic.
  3. Vertical Members: Two or more protective-coated-steel channels.
  4. Horizontal Member: Protective-coated-steel channel.
  5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.
- H. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe support made from structural-steel shape, continuous-thread rods, and rollers for mounting on permanent stationary roof curb.

## 2.7 PIPE POSITIONING SYSTEMS

- A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.
- B. 1. Acceptable Manufacturers:
  - 1. C & S Mfg. Corp.
  - 2. HOLDRITE Corp.; Hubbard Enterprises.
  - 3. Samco Stamping, Inc.

## 2.8 EQUIPMENT SUPPORTS

- A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

## 2.9 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A36/A 36M, steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C1107, factory-mixed and -packaged, dry, hydraulic-cement, non-shrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Non-staining, noncorrosive, and nongaseous.
  - 2. Design Mix: 5000-psi, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT APPLICATIONS

- A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use padded hangers for piping that is subject to scratching.
- F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
  - 3. Carbon or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.

6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
  12. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
  16. Adjustable, Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
  17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weld-less Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
  2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
  3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
  4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
  5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
  6. C-Clamps (MSS Type 23): For structural shapes.
  7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
  8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
  9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
  10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
  11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
  12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    - a. Light (MSS Type 31): 750 lb.
    - b. Medium (MSS Type 32): 1500 lb.
    - c. Heavy (MSS Type 33): 3000 lb.
  13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
  14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
  15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
  2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
  3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.
- K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

- 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
  - a. Horizontal (MSS Type 54): Mounted horizontally.
  - b. Vertical (MSS Type 55): Mounted vertically.
  - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.
- O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

### **3.2 HANGER AND SUPPORT INSTALLATION**

- A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
  - 2. Field fabricated from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- C. Fiberglass Pipe Hanger Installation: Comply with applicable portions of MSS SP-69 and MSS SP-89. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- E. Fiberglass Strut System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled fiberglass struts.
- F. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- G. Fastener System Installation:
  - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
  - 2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

- H. Pipe Stand Installation:
  - 1. Pipe Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
  - 2. Curb-Mounting-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. Refer to Division 07 Section "Roof Accessories" for curbs.
- I. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.
- J. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- K. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- L. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- M. Install lateral bracing with pipe hangers and supports to prevent swaying.
- N. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- O. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- P. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.
- Q. Insulated Piping: Comply with the following:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 4. Shield Dimensions for Pipe: Not less than the following:
    - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
    - b. NPS 4: 12 inches long and 0.06 inch thick.
    - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
    - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
    - e. NPS 16 to NPS 24: 24 inch long and 0.105 inch thick.

5. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### **3.3 EQUIPMENT SUPPORTS**

- A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make smooth bearing surface.
- C. Provide lateral bracing, to prevent swaying, for equipment supports.

### **3.4 METAL FABRICATIONS**

- A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.
- C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and with the following:
  1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
  2. Obtain fusion without undercut or overlap.
  3. Remove welding flux immediately.
  4. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

### **3.5 ADJUSTING**

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

### **3.6 PAINTING**

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

**END OF SECTION 22 05 29**

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**22 05 53**

**IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Warning signs and labels.
  - 3. Pipe labels.
  - 4. Valve tags.
  - 5. Warning tags.

**1.3 RELATED SECTIONS**

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

**1.4 REFERENCES**

- A. ANSI A13.1 - Scheme for the Identification of Piping Systems.
- B. IPC - International Plumbing Code, 2015 edition.

**1.5 SUBMITTALS**

- A. Submittals in this article are defined in Division 01 Section "Submittal Procedures" as "Action Submittals."
- B. Submit under provisions of Section 22 00 00.
- C. Submit list of wording, symbols, letter size, and color coding for plumbing identification.
- D. Product Data: Provide manufacturers' catalog literature for each type of product required, including:
  - 1. Preparation instructions and recommendations.
  - 2. Storage and handling requirements and recommendations.
  - 3. Installation methods.
- E. Samples: Submit two (2) of each type of label, tag, etc., of the approximate size specified or implied in the Specification for color, letter style, and graphic representation.
- F. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for plumbing equipment, piping and valve identification.

1. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
  2. Access Panel and Door Markers: Provide a schedule of all panels and doors to be labeled with the proposed content for each label.
  3. Pipe Label Schedule: Provide a schedule of each piping systems indicating a proposed nomenclature and location of all pipe markers.
- G. Valve Chart and Schedule: Provide a proposed valve numbering scheme and schedule for each piping system, including valve tag number, location, function, and valve manufacturer's name and model number, piping system, system abbreviation as shown on tag, normal-operating position (open, closed, or modulating), and variations for identification, to include in maintenance manuals. Mark valves intended for emergency shut-off and similar special uses.
- H. Warning Tags: Provide a schedule of all equipment to be labeled with the proposed content for each label.
- I. Manufacturer's Installation Instructions: Indicate special procedures, and installation.

#### **1.6 COORDINATION**

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

#### **1.7 PROJECT RECORD DOCUMENTS**

- A. Submit under provisions of Section 22 00 00.
- B. Record actual locations of tagged valves and update schedules accordingly.

#### **1.8 QUALITY ASSURANCE**

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience
- B. Installer Qualifications: Company specializing in performing Work of this section with minimum five (5) years documented experience.
- C. ASME Standards: Comply with ASME A13.1 for color scheme, lettering size, length of color field, and viewing angles of identification devices.

#### **1.9 DELIVERY, STORAGE, AND HANDLING**

- A. Store products in manufacturer's unopened packaging with labels clearly identifying product name and manufacturer until ready for installation.
- B. Storage: Store materials in clean, dry area indoors until ready for installation.
- C. Handling: Protect materials and finish from damage during handling and installation.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- A. All materials shall meet or exceed all applicable referenced standards, federal, state and local requirements, and conform to codes and ordinances of authorities having jurisdiction.
- B. 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 fire pumps, etc., are to be clearly marked using engraved nameplates as specified. Use equipment identification numbers that appear on the design documents and/or equipment identification numbers furnished by the Owner's Designated Representative.
- C. General: Provide manufacturer's standard products of categories and types required for each application specified. For each identification type, provide all products from same manufacturer with same text, style, color, shape, and other identification features.
  - 1. Provide nameplates with the unit number on all plumbing equipment.
  - 2. Access panel and door markers for valve cabinets, etc.
  - 3. Provide pipe identification labels including direction-of-flow arrows and with service indicated. All labels shall have background colors matched with specific service designation.
  - 4. Provide valve tag numbers on all valves.
  - 5. Warning tags at motors and equipment controlled by automatic starters, etc.

### **2.2 MANUFACTURERS**

- A. Equipment Tags, Valve Tags, and Markers:
  - 1. Brady Corporation.
  - 2. Brimar Industries.
  - 3. Craftmark.
  - 4. Graphic Products, Inc.
  - 5. Marking Services, Inc.
  - 6. Seton, owned by Brady Corporation.

### **2.3 MATERIALS**

- A. Color: Meet requirements of ANSI A13.1, unless specified otherwise.

### **2.4 EQUIPMENT LABELS**

- A. Plastic Labels for Equipment:
  - 1. Material and Thickness:
    - a. Indoors: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
    - b. Outdoors: Chemically resistant plastic with printed graphics protected by a chemical and UV resistant top laminate.
  - 2. Letter Color: White.
  - 3. Background Color: Black.
  - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
  - 5. Minimum Label Size: Length and width vary for required label content, but not less than 1 by 3 inches.
  - 6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering

for greater viewing distances. Include secondary lettering two-thirds (2/3) to three-fourths (3/4) the size of principal lettering.

7. Fasteners: Stainless-steel self-tapping screws.

B. Label Content: Nomenclature on the label is to include the name of the item, its mark number, area, space, or equipment served, and other pertinent information. Use equipment identification numbers that appear on the design documents and/or equipment identification numbers furnished by the Owner..

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

D. All scheduled equipment shall be identified with an Equipment Tag.

## **2.5 ACCESS PANEL AND DOOR MARKERS**

A. Material and Thickness: 1/8-inch- thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification.

B. Letter Color: White

C. Background Color: Black

D. Fasteners: Self-tapping, stainless steel screws or contact-type, permanent adhesive.

## **2.6 WARNING SIGNS AND LABELS**

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

## **2.7 PIPE LABELS (INDOOR PIPING)**

- A. Provide labels for above ground piping located indoors, and not exposed to sunlight or a harsh environment.
- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction in conformance with ANSI A13.1.
- B. Plastic Labels for Pipe O.D. less than 8 inches: Pre-coiled, semi-rigid plastic formed to cover full circumference of pipe or pipe covering and to attach to pipe without fasteners or adhesive in contact with the pipe surface.
- B. Pipe Labels for Pipe O.D. 8 inches and Over: Strap-on, semi rigid plastic to cover partial circumference of pipe and to attach to pipe with nylon ties.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.
- D. Pipe markers and arrow markers also shall be provided for all piping systems.

## **2.8 PIPE LABELS (OUTDOOR PIPING)**

- A. Provide labels for above ground piping located outside, and exposed to sunlight or a harsh environment, the following product is specified.
- B. Pre-printed, color-coded, with lettering indicating service, and showing flow direction.
- C. Pipe markers shall be constructed of printed 5 mil polyester and top laminated with ultraviolet and chemical resistant plastic film that is engineered to provide maximum durability of the printed legend. Markers shall be pre-coiled to wrap entirely around the circumference of pipe up to 10 inch outside diameter, and self-sealed with a strip of clear ultraviolet and chemical resistant plastic film. Coiled markers shall seal to themselves, and not the pipe surface.
- D. Pipe Labels for pipe O.D. up to 10 inches: Shall be labeled with a single piece, pre-printed marker that wraps entirely around the circumference of the pipe, overlaps and seals to itself rather than adhere to the pipe surface.
- E. Pipe Labels for pipe O.D. 10 inches and greater: Shall be constructed of printed 5 mil polyester and top laminated with clear ultraviolet and chemical resistant plastic film that is pre-applied to an acrylic-faced, co-extruded ABS plastic carrier. Carrier shall have pre-formed legs running the entire length of the part to ensure marker remains straight and aligned with pipe. Flow direction shall be identified by application of a separate arrow label of same construction. Carriers shall be affixed to piping by means of two (2) stainless steel straps that wrap entirely around the circumference of the pipe.
- F. Underground Plastic Pipe markers: Bright colored continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

## 2.9 VALVE TAGS

- A. Provide and install identification tags lettered and numbered to correspond to the information shown on the charts described above.
- B. Valve tags shall conform to ANSI A13.1.
- C. Valve Tags (Indoor): Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  - 1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
  - 2. Background Color: Natural brass.
  - 3. Letter Color: Black.
  - 4. Tag Size: 1-1/2 inches, round.
  - 5. Fasteners: Brass S-hooks and Jack chain
- D. Valve Tags (Outdoor):
  - 1. Material: Chemically resistant plastic with printed graphics protected by a chemical and UV resistant top laminate, and having stainless steel grommet protected predrilled holes with for attachment hardware.
  - 2. Background Color: Red.
  - 3. Letter Color: White.
  - 4. Tag Size: Minimum 1-1/2 inches.
  - 5. Fasteners: Stainless steel S-Hooks and stainless steel Jack Chain.
- E. Valve Schedules:
  - 1. For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
  - 2. Valve-tag schedule shall be included in operation and maintenance data.

## 2.10 CEILING TACKS

- A. Description: Steel with 3/4 inch or 7/8" diameter color coded head.
- B. Color code: Red.

## 2.11 CEILING GRID TAG FOR EQUIPMENT LOCATED ABOVE LAY-IN CEILING

- A. Description: 3/4" x variable length vinyl label, 3.0 mil self-adhesive vinyl similar to Graphic Products, Inc. DuraLabel Pro™. Label color shall be black text on a white background.
- B. All scheduled equipment above finish lay-in ceiling shall be identified with an Equipment Tag.
- C. All ceiling grid tags shall be installed prior to the ceiling cover inspection.

## 2.12 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.

- C. Background Color: Red.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds (2/3) to three-fourths (3/4) the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. In paragraph below, describe required label content. The objective of labeling equipment is to coordinate it with Drawings, including plans, details, and schedules. This will allow other information, such as capacities and operating characteristics, to be obtained.
- I. Label Content: Include caution and warning information, plus emergency notification instructions.

### **2.13 WARNING TAGS**

- A. Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
- B. Size: 3 by 5-1/4 inches minimum.
- C. Fasteners: Reinforced grommet and wire or string.
- D. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
- E. Color: Yellow background with black lettering.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Do not begin installation until substrates have been properly prepared.
- B. Install identifying devices after completion of coverings and painting.
- C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

### **3.2 PREPARATION**

- A. A. Thoroughly clean all surfaces to be painted as required to remove all oil, grease, loose scale, rust, and foreign matter. Piping must be completely dry at the time of application. The painting of piping associated with an operating system is strictly prohibited. Site touch-up of the factory applied coating or paint, to include preparation and painting of field welds, must be completed and approved by the Engineer prior to installation of insulation (No Exceptions).

- B. For pipe markers that are pre-coiled or strap-on type and do not adhere directly to the piping, no surface preparation is necessary.

### **3.3 INSTALLATION**

- A. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.
- B. All installation shall be in accordance with manufacturer's published recommendations.

### **3.4 EQUIPMENT LABEL INSTALLATION**

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.

### **3.5 ACCESS PANEL AND DOOR MARKERS INSTALLATION**

- A. Install or permanently fasten markers on access panels and door for fire suppression equipment.
- B. Locate labels where accessible and visible.

### **3.6 PIPE LABEL INSTALLATION**

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. All plumbing piping shall be labeled to identify the system. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums (and other spaces not visible to building occupants but accessible to maintenance personnel); and exterior exposed locations as follows:
  - 1. Near each valve and control device to indicate proper identification of pipe contents. Where several valves exist on one (1) header, it is necessary to mark only the header.
  - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Every 20 feet in exposed and concealed areas on all piping systems. Provide at least one (1) pipe marker in each room on all piping systems.
  - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- 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. Install plastic tape, and pipe markers completely around pipe in accordance with manufacturer's instructions.
- E. Locate markers on the two (2) lower quarters of the pipe where view is unobstructed.

- F. Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

### **3.7 VALVE-TAG INSTALLATION**

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
  - 1. Other valve-tag sizes, shapes, colors, and letter colors may be available if required.
  - 2. Valve-Tag Size and Shape:
    - a. Cold Water: 1-1/2 inches, round.
    - b. Hot Water: 1-1/2 inches, round.
    - c. Low-Pressure Compressed Air: 1-1/2 inches, round.
  - 3. Select contrasting valve-tag color and letter color in two subparagraphs below for each service. Retain "Natural" option for brass or stainless-steel valve tags.
  - 4. Valve-Tag Color:
    - a. Cold Water: Natural.
    - b. Hot Water: Natural.
  - 5. Letter Color:
    - a. Cold Water: Black.
    - b. Hot Water: Black.

### **3.8 WARNING-TAG INSTALLATION**

- A. Write required message on, and attach warning tags to, equipment and other items where required.

### **3.9 CEILING TACKS**

- A. Mark location of equipment or valves located above ceilings with identifying "buttons" to help in identification for maintenance.

### **3.10 CEILING GRID TAGS**

- A. Provide ceiling grid tags to locate valves or other concealed equipment above T-bar type panel ceilings. Locate in corner of grid closest to equipment.

### **3.11 PROTECTION**

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

### **3.12 VALVE CHART AND SCHEDULE**

- A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install one (1) in each individual equipment room at locations as directed A/E or Owner.
- B. Provide full piping graphics design in aluminum frame with clear plastic shield. Install one (1) in each individual equipment room at locations as directed by A/E or Owner.

**3.13 COLOR CODE FOR MARKING PIPE**

Material	Band	Color	Letters & Arrows	Legend
Cold Water (Potable)	Dk. Blue	SW 4056	White	POTABLE
Non-Potable Water	Dk. Blue	SW 4056	White	NON-POT
Fire Protection Water	Red	SW 4081	White	FIRE PR.
Hot Water (Domestic)	Green	SW 4085	White	H.W.
Hot Water Recirculating (Domestic)	Green	SW 4085	White	H.W.R.

**3.14 COLOR CODE MARKING SIZES**

Outside Diameter of Pipe Covering (Inches)	Length of Color Band (Inches)	Arrow Length by Width (Inches)	Size of Legend Letters and Numerals (Inches)
Less than 1-1/2	8	8 x 2-1/4	1/2
1-1/2 to 2-3/8	8	8 x 2-1/4	3/4
2-1/2 to 7-7/8	12	8 x 2-1/4	1-1/4
8 to 10	24	12 x 4-1/2	2-1/2
Over 10	32	12 x 4-1/2	3-1/2

**END OF SECTION 22 05 53**

**22 07 00**

**PLUMBING INSULATION**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
1. Insulation Materials:
    - a. Cellular glass.
    - b. Flexible elastomeric.
    - c. Mineral fiber.
    - d. Phenolic.
  2. Insulating cements.
  3. Adhesives.
  4. Mastics.
  5. Lagging adhesives.
  6. Sealants.
  7. Factory-applied jackets.
  8. Field-applied jackets.
  9. Tapes.
  10. Securements.
  11. Corner angles.

**1.3 RELATED SECTIONS INCLUDE THE FOLLOWING:**

- A. Division 23 Section "HVAC Insulation."

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Shop Drawings:
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  2. Detail attachment and covering of heat tracing inside insulation.
  3. Detail insulation application at pipe expansion joints for each type of insulation.
  4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  5. Detail removable insulation at piping specialties, equipment connections, and access panels.
  6. Detail application of field-applied jackets.
  7. Detail application at linkages of control devices.
  8. Detail field application for each equipment type.

- C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:
  - 1. Sample Sizes:
    - a. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
    - b. Sheet Form Insulation Materials: 12 inches square.
    - c. Jacket Materials for Pipe: 12 inches long by NPS 2.
    - d. Sheet Jacket Materials: 12 inches square.
    - e. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.
- D. Qualification Data: For qualified Installer.
- E. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- F. Field quality-control reports.

### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.
- C. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
  - 1. Piping Mockups:
    - a. One (1) 10-foot section of NPS 2 straight pipe.
    - b. One (1) each of a 90-degree threaded, welded, and flanged elbow.
    - c. One (1) each of a threaded, welded, and flanged tee fitting.
    - d. One (1) NPS 2 or smaller valve, and one NPS 2-1/2 or larger valve.
    - e. Four (4) support hangers including hanger shield and insert.
    - f. One (1) threaded strainer and one flanged strainer with removable portion of insulation.
    - g. One (1) threaded reducer and one welded reducer.
    - h. One (1) pressure temperature tap.
    - i. One (1) mechanical coupling.
  - 2. Equipment Mockups: One (1) tank or vessel.
  - 3. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
  - 4. Notify Architect seven (7) days in advance of dates and times when mockups will be constructed.

5. Obtain Architect's approval of mockups before starting insulation application.
6. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
7. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
8. Demolish and remove mockups when directed.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

#### **1.7 COORDINATION**

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application and equipment Installer for equipment insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

#### **1.8 SCHEDULING**

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

### **PART 2 - PRODUCTS**

#### **2.1 INSULATION MATERIALS**

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
  1. Armstrong World Industries, Inc.
  2. Certainteed Corp.
  3. Knauf Fiber Glass GmbH.
  4. Owens-Corning Fiberglas Corp.
  5. FGH Fabricators, Inc.
- B. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.
- C. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- D. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C871.

- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

## 2.2 PIPING INSULATION MATERIALS

- A. Fiberglass Piping Insulation: ASTM C547, Class 1 unless otherwise indicated. (Indoor locations).
- B. Cellular Glass Insulation: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide the following provide one of the following:
    - a. Cell-U-Foam Corporation; Ultra-CUF.
    - b. Owens Corning Corporation; Foamglas Super K.
  - 2. Block Insulation: ASTM C552, Type 1.
  - 3. Special-Shaped Insulation: ASTM C 552, Type III.
  - 4. Board Insulation: ASTM C 552, Type IV.
  - 5. Preformed Pipe Insulation with Factory-Applied ASJ ASJ-SSL: Comply with ASTM C552, Type II, Class 2.
  - 6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.
- C. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Aeroflex USA Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.
- D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type I. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. CertainTeed Corp.; Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; All-Service Duct Wrap.
- E. High-Temperature, Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C553, Type V, without factory-applied jacket.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Johns Manville; HTB 23 Spin-Glas.
    - b. Owens Corning; High Temperature Flexible Batt Insulations.
- F. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000(Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied ASJ complying with ASTM C1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide the following:
    - a. CertainTeed Corp.; CrimpWrap.
    - b. Johns Manville; MicroFlex.
    - c. Knauf Insulation; Pipe and Tank Insulation.
    - d. Manson Insulation Inc.; AK Flex.
    - e. Owens Corning; Fiberglas Pipe and Tank Insulation.
- H. Phenolic:
1. Products: Subject to compliance with requirements, provide the following:
    - a. Kingspan Corp.; Koolphen K.
  2. Preformed pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III, Grade 1.
  3. Block insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type II, Grade 1.
  4. Factory fabricate shapes according to ASTM C450 and ASTM C585.
  5. Factory-Applied Jacket: Requirements are specified in "Factory-Applied Jackets" Article.
    - a. Preformed Pipe Insulation: ASJ.
    - b. Board for Equipment Applications: ASJ.
- I. Polyolefin: Unicellular, polyethylene thermal plastic insulation. Comply with ASTM C 534 or ASTM C 1427, Type I, Grade 1 for tubular materials and Type II, Grade 1 for sheet materials.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Armacell LLC; Tubolit.
    - b. Nomaco Inc.; IMCOLOCK, IMCOSHEET, NOMALOCK, and NOMAPLY.
    - c. RBX Corporation; Therma-cell.
- J. Polystyrene: Rigid, extruded cellular polystyrene intended for use as thermal insulation. Comply with ASTM C 578, Type IV or Type XIII, except thermal conductivity (k-value) shall not exceed 0.26 Btu x in./h x sq. ft. x deg F after 180 days of aging. Fabricate shapes according to ASTM C 450 and ASTM C 585.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Styrofoam.
    - b. Knauf Insulation; Knauf Polystyrene.
- K. Jackets for Piping Insulation: ASTM C921, Type I (vapor barrier) for piping with temperatures below ambient, Type II (water vapor permeable) for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
1. Encase pipe fittings insulation with one-piece pre-molded 16 mil aluminum fitting covers, fastened as per manufacturer's recommendations.
  2. Encase exterior piping insulation with 16 MIL aluminum jacket with "Z" closures for weather-proof construction.
- L. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

- M. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated. White all service jacket "ASJ" vapor barrier with dual self-seal strips for all insulation except flexible unicellular.

### 2.3 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C195.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Insulco, Division of MFS, Inc.; Triple I.
    - b. P. K. Insulation Mfg. Co., Inc.; Super-Stik.
- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
2. Products: Subject to compliance with requirements, provide one of the following:
    - a. P. K. Insulation Mfg. Co., Inc.; Thermal-V-Kote.
- C. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.
3. Products: Subject to compliance with requirements, provide one of the following:
    - a. Insulco, Division of MFS, Inc.; SmoothKote.
    - b. P. K. Insulation Mfg. Co., Inc.; PK No. 127, and Quik-Cote.
    - c. Rock Wool Manufacturing Company; Delta One Shot.

### 2.4 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Cellular-Glass, Phenolic, Polyisocyanurate, and Polystyrene Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-96.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-33.
- C. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA Inc.; Aeroseal.
    - b. Armacell LCC; 520 Adhesive.
    - c. Foster Products Corporation, H. B. Fuller Company; 85-75.
    - d. RBX Corporation; Rubatex Contact Adhesive.
- D. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
- E. Polystyrene Adhesive: Solvent- or water-based, synthetic resin adhesive with a service temperature range of minus 20 to plus 140 deg F.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-96.
    - b. Foster Products Corporation, H. B. Fuller Company; 97-13.

- F. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-82.
    - b. Foster Products Corporation, H. B. Fuller Company; 85-20.
    - c. ITW TACC, Division of Illinois Tool Works; S-90/80.
    - d. Marathon Industries, Inc.; 225.
    - e. Mon-Eco Industries, Inc.; 22-25.
  
- G. PVC Jacket Adhesive: Compatible with PVC jacket.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); 739, Dow Silicone.
    - b. Johns-Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Speedline Vinyl Adhesive.

## 2.5 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
  
- B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-35.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-90.
    - c. ITW TACC, Division of Illinois Tool Works; CB-50.
    - d. Marathon Industries, Inc.; 590.
    - e. Mon-Eco Industries, Inc.; 55-40.
    - f. Vimasco Corporation; 749.
  - 2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
  - 4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
  - 5. Color: White.
  
- C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Products, Division of ITW; CP-10.
    - b. Foster Products Corporation, H. B. Fuller Company; 35-00.
    - c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
    - d. Marathon Industries, Inc.; 550.
    - e. Mon-Eco Industries, Inc.; 55-50.
    - f. Vimasco Corporation; WC-1/WC-5.
  - 2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
  - 3. Service Temperature Range: Minus 20 to plus 200 deg F.
  - 4. Solids Content: 63 percent by volume and 73 percent by weight.
  - 5. Color: White.

## 2.6 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-52.

- b. Foster Products Corporation, H. B. Fuller Company; 81-42.
- c. Marathon Industries, Inc.; 130.
- d. Mon-Eco Industries, Inc.; 11-30.
- e. Vimasco Corporation; 136.
2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
3. Service Temperature Range: Minus 50 to plus 180 deg F.
4. Color: White.

## 2.7 SEALANTS

### A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Pittsburgh Corning Corporation; Pittseal 444.
  - f. Vimasco Corporation; 750.
2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-70.
  - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
3. Materials shall be compatible with insulation materials, jackets, and substrates.
4. Permanently flexible, elastomeric sealant.
5. Service Temperature Range: Minus 100 to plus 300 deg F.
6. Color: White or gray.

### B. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76-8.
  - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
  - c. Marathon Industries, Inc.; 405.
  - d. Mon-Eco Industries, Inc.; 44-05.
  - e. Vimasco Corporation; 750.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: Aluminum.

### C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Childers Products, Division of ITW; CP-76.
2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

## 2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## 2.9 FIELD-APPLIED FABRIC-REINFORCING MESH

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Products, Division of ITW; Chil-Glas No. 5.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## 2.10 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## 2.11 FIELD-APPLIED JACKETS

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.
    - a. Factory cut and rolled to size.
    - b. Finish and thickness are indicated in field-applied jacket schedules.
    - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
    - e. Factory-Fabricated Fitting Covers:
      - 1) Same material, finish, and thickness as jacket.
      - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      - 3) Tee covers.
      - 4) Flange and union covers.
      - 5) End caps.
      - 6) Beveled collars.
      - 7) Valve covers.
      - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.

- d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 6 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.

## 2.13 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products; Bands.
    - b. PABCO Metals Corporation; Bands.
    - c. RPR Products, Inc.; Bands.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
  3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
  4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.

- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; Cupped Head Weld Pin.
      - 3) Midwest Fasteners, Inc.; Cupped Head.
      - 4) Nelson Stud Welding; CHP.
  3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      - 2) GEMCO; Perforated Base.
      - 3) Midwest Fasteners, Inc.; Spindle.
    - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) GEMCO; Nylon Hangers.
      - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
    - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
    - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
    - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
  5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      - 2) GEMCO; Press and Peel.
      - 3) Midwest Fasteners, Inc.; Self Stick.
    - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
    - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

- d. Adhesive-backed base with a peel-off protective cover.
- 6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- 7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) GEMCO.
    - 2) Midwest Fasteners, Inc.

#### **2.14 CORNER ANGLES**

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

#### **2.15 LAGGING ADHESIVES**

- A. Description: Comply with MIL-A-3316C, Class I, Grade A, and shall be compatible with insulation materials, jackets, and substrates.
  - 1. For indoor applications, use lagging adhesives that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-52.
    - b. Foster Products Corporation, H. B. Fuller Company; 81-42.
    - c. Marathon Industries, Inc.; 130.
    - d. Mon-Eco Industries, Inc.; 11-30.
    - e. Vimasco Corporation; 136.
  - 3. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over equipment and pipe insulation.
  - 4. Service Temperature Range: Minus 50 to plus 180 deg F.
  - 5. Color: White.

#### **2.16 SEALANTS**

- A. Joint Sealants:
  - 1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-45.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.

- e. Pittsburgh Corning Corporation; Pittseal 444.
  - f. Vimasco Corporation; 750.
  2. Joint Sealants for Polystyrene Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-70.
    - b. Foster Products Corporation, H. B. Fuller Company; 30-45/30-46.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Vimasco Corporation; 750.
  3. Materials shall be compatible with insulation materials, jackets, and substrates.
  4. Permanently flexible, elastomeric sealant.
  5. Service Temperature Range: Minus 100 to plus 300 deg F.
  6. Color: White or gray.
  7. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. FSK and Metal Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76-8.
    - b. Foster Products Corporation, H. B. Fuller Company; 95-44.
    - c. Marathon Industries, Inc.; 405.
    - d. Mon-Eco Industries, Inc.; 44-05.
    - e. Vimasco Corporation; 750.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F.
  5. Color: Aluminum.
  6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; CP-76.
  2. Materials shall be compatible with insulation materials, jackets, and substrates.
  3. Fire- and water-resistant, flexible, elastomeric sealant.
  4. Service Temperature Range: Minus 40 to plus 250 deg F.
  5. Color: White.
  6. For indoor applications, use sealants that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.17 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
  2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
  3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
  4. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
    - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

## **2.18 FIELD-APPLIED FABRIC-REINFORCING MESH**

- A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Vimasco Corporation; Elastafab 894.
- B. Woven Glass-Fiber Fabric for Equipment Insulation: Approximately 6 oz./sq. yd. with a thread count of 5 strands by 5 strands/sq. inch for covering equipment.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Childers Products, Division of ITW; Chil-Glas No. 5.
- C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for equipment and pipe.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Products Corporation, H. B. Fuller Company; Mast-A-Fab.
    - b. Vimasco Corporation; Elastafab 894.

## **2.19 FIELD-APPLIED CLOTHS**

- A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Alpha Associates, Inc.; Alpha-Maritex 84215 and 84217/9485RW, Luben 59.

## **2.20 FIELD-APPLIED JACKETS**

- A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Zeston.
    - b. P.I.C. Plastics, Inc.; FG Series.
    - c. Proto PVC Corporation; LoSmoke.
    - d. Speedline Corporation; SmokeSafe.
  2. Adhesive: As recommended by jacket material manufacturer.
  3. Color: White.
  4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
    - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
  5. Factory-fabricated tank heads and tank side panels.
- C. Metal Jacket:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products, Division of ITW; Metal Jacketing Systems.
    - b. PABCO Metals Corporation; Surefit.
    - c. RPR Products, Inc.; Insul-Mate.
  2. Aluminum Jacket: Comply with ASTM B 209, Alloy 3003, 3005, 3105 or 5005, Temper H-14.

- a. Factory cut and rolled to size.
- b. Finish and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
- e. Factory-Fabricated Fitting Covers:
  - 1) Same material, finish, and thickness as jacket.
  - 2) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
  - 3) Tee covers.
  - 4) Flange and union covers.
  - 5) End caps.
  - 6) Beveled collars.
  - 7) Valve covers.
  - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

## 2.21 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
    - b. Compac Corp.; 104 and 105.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
    - b. Compac Corp.; 110 and 111.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
    - d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.
  2. Width: 3 inches.
  3. Thickness: 6.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
  1. Products: Subject to compliance with requirements, provide the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
    - b. Compac Corp.; 130.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
    - d. Venture Tape; 1506 CW NS.

- e. <Insert manufacturer's name; product name or designation.>
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.
- D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
    - b. Compac Corp.; 120.
    - c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
    - d. Venture Tape; 3520 CW.
  2. Width: 2 inches.
  3. Thickness: 3.7 mils.
  4. Adhesion: 100 ounces force/inch in width.
  5. Elongation: 5 percent.
  6. Tensile Strength: 34 lbf/inch in width.
- E. PVDC Tape: White vapor-retarder PVDC tape with acrylic adhesive.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
  2. Width: 3 inches.
  3. Film Thickness: 6 mils.
  4. Adhesive Thickness: 1.5 mils.
  5. Elongation at Break: 145 percent.
  6. Tensile Strength: 55 lbf/inch in width.

## 2.22 SECUREMENTS

- A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Products; Bands.
    - b. PABCO Metals Corporation; Bands.
    - c. RPR Products, Inc.; Bands.
  2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.
  3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing or closed seal.
  4. Springs: Twin spring set constructed of stainless steel with ends flat and slotted to accept metal bands. Spring size determined by manufacturer for application.
- B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) AGM Industries, Inc.; CWP-1.
      - 2) GEMCO; CD.
      - 3) Midwest Fasteners, Inc.; CD.
      - 4) Nelson Stud Welding; TPA, TPC, and TPS.
  2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
    - a. Products: Subject to compliance with requirements, provide one of the following:

- 1) AGM Industries, Inc.; CWP-1.
  - 2) GEMCO; Cupped Head Weld Pin.
  - 3) Midwest Fasteners, Inc.; Cupped Head.
  - 4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
    - 2) GEMCO; Perforated Base.
    - 3) Midwest Fasteners, Inc.; Spindle.
  - b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) GEMCO; Nylon Hangers.
    - 2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
  - b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
  - c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
  - d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
    - 2) GEMCO; Press and Peel.
    - 3) Midwest Fasteners, Inc.; Self Stick.
  - b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
  - c. Spindle: Aluminum, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.
  - d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, aluminum sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
- a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) AGM Industries, Inc.; RC-150.
    - 2) GEMCO; R-150.
    - 3) Midwest Fasteners, Inc.; WA-150.
    - 4) Nelson Stud Welding; Speed Clips.
  - b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
  - a. Products: Subject to compliance with requirements, provide one of the following:
    - 1) GEMCO.
    - 2) Midwest Fasteners, Inc.

## **2.23 CORNER ANGLES**

- A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
- B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.
- C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
  1. Verify that systems and equipment to be insulated have been tested and are free of defects.
  2. Verify that surfaces to be insulated are clean and dry.
  3. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 PREPARATION**

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

### **3.3 GENERAL INSTALLATION REQUIREMENTS**

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches O.C.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches O.C.
    - a. For below ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. Manholes.

5. Handholes.
6. Cleanouts.

### 3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
  4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
  1. Seal penetrations with flashing sealant.
  2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
  3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
  4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
  1. Comply with requirements in Division 07 Section "Penetration Firestopping" and fire-resistant joint sealers.
- F. Insulation Installation at Floor Penetrations:
  1. Pipe: Install insulation continuously through floor penetrations.
  2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.5 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
  1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:

- a. Do not weld anchor pins to ASME-labeled pressure vessels.
  - b. Select insulation hangers and adhesive that are compatible with service temperature and with substrate.
  - c. On tanks and vessels, maximum anchor-pin spacing is 3 inches from insulation end joints, and 16 inches O.C. in both directions.
  - d. Do not over compress insulation during installation.
  - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
  - f. Impale insulation over anchor pins and attach speed washers.
  - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches from each end. Install wire or cable between two (2) circumferential girdles 12 inches O.C. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches O.C. Use this network for securing insulation with tie wire or bands.
  7. Stagger joints between insulation layers at least 3 inches.
  8. Install insulation in removable segments on equipment access doors, manholes, hand holes, and other elements that require frequent removal for service and inspection.
  9. Bevel and seal insulation ends around manholes, hand holes, ASME stamps, and nameplates.
  10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- B. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch- diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
  2. Fabricate boxes from aluminum, at least 0.040 inch 0.050 inch 0.060 inch thick.
  3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

### **3.6 GENERAL PIPE INSULATION INSTALLATION**

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached

insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### **3.7 CELLULAR-GLASS INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches O.C.
  4. For insulation with factory-applied jackets on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
  1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed sections of cellular-glass insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### **3.8 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION**

- A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.

4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed valve covers manufactured of same material as pipe insulation when available.
  2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.9 MINERAL-FIBER INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches O.C.
  4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

4. Install insulation to flanges as specified for flange insulation application.

### **3.10 PHENOLIC INSULATION INSTALLATION**

- A. General Installation Requirements:
  1. Secure single-layer insulation with stainless-steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
  2. Install 2-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless-steel bands at 12-inch intervals.
- B. Insulation Installation on Straight Pipes and Tubes:
  1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
  2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
  3. For insulation with factory-applied jackets on above ambient services, secure laps with outward clinched staples at 6 inches O.C.
  4. For insulation with factory-applied jackets with vapor retarders on below ambient services, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- C. Insulation Installation on Pipe Flanges:
  1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as pipe insulation.
- D. Insulation Installation on Pipe Fittings and Elbows:
  1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- E. Insulation Installation on Valves and Pipe Specialties:
  1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### **3.11 POLYOLEFIN INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
  1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulation Installation on Pipe Flanges:
  1. Install pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as pipe insulation.
  4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install mitered sections of polyolefin pipe insulation.
  2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.
  4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

### **3.12 POLYSTYRENE INSULATION INSTALLATION**

- A. Insulation Installation on Straight Pipes and Tubes:
1. Secure each layer of insulation with tape or bands and tighten bands without deforming insulation materials. Orient longitudinal joints between half sections in 3 and 9 o'clock positions on the pipe.
  2. For insulation with factory-applied jackets with vapor barriers, do not staple longitudinal tabs but secure tabs with additional adhesive or tape as recommended by insulation material manufacturer and seal with vapor-barrier mastic.
  3. All insulation shall be tightly butted and free of voids and gaps at all joints. Vapor barrier must be continuous. Before installing jacket material, install vapor-barrier system.
- B. Insulation Installation on Pipe Flanges:
1. Install preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation section same as overall width of flange and bolts, same thickness of adjacent pipe insulation, not to exceed 1-1/2-inch thickness.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polystyrene block insulation of same thickness as pipe insulation.
- C. Insulation Installation on Pipe Fittings and Elbows:
1. Install preformed insulation sections of same material as straight segments of pipe insulation. Secure according to manufacturer's written instructions.
- D. Insulation Installation on Valves and Pipe Specialties:
1. Install preformed section of polystyrene insulation to valve body.
  2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
  3. Install insulation to flanges as specified for flange insulation application.

### **3.13 FIELD-APPLIED JACKET INSTALLATION**

- A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.
1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.

2. Embed glass cloth between two 0.062-inch- thick coats of lagging adhesive.
  3. Completely encapsulate insulation with coating, leaving no exposed insulation.
- B. Where FSK jackets are indicated, install as follows:
1. Draw jacket material smooth and tight.
  2. Install lap or joint strips with same material as jacket.
  3. Secure jacket to insulation with manufacturer's recommended adhesive.
  4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
  5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches O.C. and at end joints.

### **3.14 FINISHES**

- A. Equipment and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 09 painting Sections.
1. Flat Acrylic Finish: Two (2) finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

### **3.15 FIELD QUALITY CONTROL**

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
- C. Tests and Inspections:
1. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
  2. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two

locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

### **3.16 PLUMBING PIPING SYSTEM INSULATION**

- A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers, check valves, balance cocks, flow regulators, buried piping, fire protection piping, and pre-insulated equipment.

### **3.17 EQUIPMENT INSULATION SCHEDULE**

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Domestic hot-water pump insulation shall be one of the following:
  - 1. Cellular Glass: 2 inches thick.
  - 2. Phenolic: 1 inch thick.
- D. Domestic cold water, and domestic hot-water hydro-pneumatic tank insulation shall be one of the following:
  - 1. Cellular Glass: 1-1/2 inches thick.
  - 2. Flexible Elastomeric: 1 inch thick.
  - 3. Mineral-Fiber Pipe and Tank: 1 inch thick.
- E. Domestic hot-water storage tank insulation shall be one of the following, of thickness to provide an R-value of 12.5:
  - 1. Cellular glass.
  - 2. Mineral-fiber pipe and tank.
  - 3. Phenolic.
- F. Provide an insulated enclosure for all backflow preventers, outdoors, above grade. Similar to Hubbell "Lok Box" or Watts "WattsBox".

### **3.18 PIPING INSULATION SCHEDULE, GENERAL**

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### **3.19 INDOOR PIPING INSULATION SCHEDULE**

- A. Domestic Cold Water:
  - 1. NPS 1 and Smaller: Insulation shall be one of the following:
    - a. Outdoors: Phenolic Foam: [**<insert>**] inches thick.

- b. Indoors: Fiberglass: [**<insert>**] inch thick.
  2. NPS 1-1/4 and Larger: Insulation shall be one of the following:
    - a. Outdoors: Phenolic Foam: [**<insert>**] inches thick.
    - b. Indoors: Fiberglass: [**<insert>**] inch thick.
  3. Provide thermal pipe insulation on all cold water lines subject to freezing, main water entry pipe for 50 linear feet within building and within exterior walls out to five feet into plenum.
  4. Insulate entire wall hydrant box, valve and piping in exterior walls.
- B. Domestic Hot water and Re-circulated Hot Water:
  1. NPS 1-1/4 and Smaller: Insulation shall be one of the following:
    - a. Outdoors: Phenolic Foam: [**<insert>**] inches thick.
    - b. Indoors: Fiberglass: [**<insert>**] inch thick.
  2. NPS 1-1/2 and Larger: Insulation shall be one of the following:
    - a. Outdoors: Phenolic Foam: [**<insert>**] inches thick.
    - b. Indoors: Fiberglass: [**<insert>**] inch thick.
  3. Provide thermal pipe insulation on all piping carrying domestic hot water.
- C. Storm water and Overflow:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Flexible Elastomeric: 1 inch thick.
- D. Roof Drain and Overflow Drain Bodies:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Flexible Elastomeric: 1 inch thick.
  2. Insulate all roof drains from the drain body to vertical downspout. Include all horizontal roof drain piping, which occurs above the finished floor ceiling line. Insulate entire roof drain hangers, up to threaded rod.
- E. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Flexible Elastomeric: 3/4 inch thick.
    - b. Polyolefin: 3/4 inch thick.
- F. Condensate and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Flexible Elastomeric: 1 inch thick.
- G. Floor Drains, Traps, and Sanitary Drain Piping within 10 Feet of Drain Receiving Condensate and Equipment Drain Water below 60 Deg F:
  1. All Pipe Sizes: Insulation shall be one of the following:
    - a. Cellular Glass: 1-1/2 inches thick.
    - b. Flexible Elastomeric: 1 inch thick.

### **3.20 INDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.

- C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches: PVC, Color-Coded by System: 20 mils thick
- D. Equipment, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches: Aluminum, Smooth 0.024 inch thick.
- A. Piping, Concealed: PVC, Color-Coded by System: 20 mils thick.
- B. Piping, Exposed: Aluminum, Smooth 0.024 inch thick.

**3.21 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE**

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Equipment, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
  - 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.
- D. Piping, Exposed:
  - 1. Aluminum, Smooth with Z-Shaped Locking Seam: 0.024 inch thick.

**3.22 UNDERGROUND, FIELD-INSTALLED INSULATION JACKET**

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

**END OF SECTION 22 07 00**

22 11 16

**DOMESTIC WATER PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Under-building slab and aboveground domestic water pipes, tubes, fittings, and specialties inside the building.
  - 2. Encasement for piping.
  - 3. Specialty valves.
  - 4. Flexible connectors.
  - 5. Escutcheons.
  - 6. Sleeves and sleeve seals.
  - 7. Wall penetration systems.

**1.3 SUBMITTALS**

- A. Product Data: For the following products:
  - 1. Specialty valves.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Flexible connectors.
  - 5. Backflow preventers and vacuum breakers.
  - 6. Escutcheons.
  - 7. Sleeves and sleeve seals.
  - 8. Water penetration systems.
- B. Water Samples: Specified in "Cleaning" Article.
- C. Field quality-control reports.

**1.4 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- A. Comply with NSF 61 for potable domestic water piping and components.

**1.5 PROJECT CONDITIONS**

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect and Construction Manager no fewer than two (2) days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Architect's and Construction Manager's written permission.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL**

- 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 shall be installed using the materials and methods as specified in the following paragraphs.

### **2.2 COPPER TUBE AND FITTINGS**

- A. Hard Copper Tube: ASTM B88, Type L water tube, drawn temper.
- B. Soft Copper Tube: ASTM B88, Type K (ASTM B88M, Type A) water tube, annealed temper.
- C. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
- D. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
- E. "Tube pull" or "Tee drill" fittings are NOT ALLOWED.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- G. Unions in first subparagraph below are available in NPS 1/4 to NPS 4.
  1. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

### **2.3 STAINLESS-STEEL PIPING**

- A. Potable-water piping and components shall comply with NSF 61 Annex G.
- B. Stainless-Steel Pipe: ASTM A312/A312M, Schedule 10.
- C. Stainless-Steel Pipe Fittings: ASTM A815/A815M.
- D. Appurtenances for Grooved-End, Stainless-Steel Pipe:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Anvil International.
    - b. Apollo-Shurjoint Piping Products USA Inc.
    - c. Grinnell Mechanical Products.
    - d. Victaulic Company.
  2. Fittings for Grooved-End, Stainless-Steel Pipe: Stainless-steel casting with dimensions matching stainless-steel pipe.

## **2.4 DUCTILE-IRON PIPE AND FITTINGS (FOR UNDERGROUND USE)**

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151 cement mortar lined ductile iron pipe, with mechanical-joint bell and plain spigot end.
- B. Standard-Pattern, Mechanical-Joint Fittings: AWWA C110, ductile or gray iron.

## **2.5 PIPING JOINING MATERIALS**

- A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free, unless otherwise indicated; full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.

## **2.6 SPECIALTY VALVES**

- A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.
- B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, and vacuum breakers.

## **2.7 TRANSITION FITTINGS**

- A. General Requirements:
  - 1. Same size as pipes to be joined.
  - 2. Pressure rating at least equal to pipes to be joined.
  - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the following:
    - a. Cascade Waterworks Manufacturing.
    - b. Dresser, Inc.; Dresser Piping Specialties.
    - c. Ford Meter Box Company, Inc. (The).
    - d. JCM Industries.
    - e. Romac Industries, Inc.
    - f. Smith-Blair, Inc; a Sensus company.
    - g. Viking Johnson; c/o Mueller Co.

## 2.8 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials or ferrous material body with separating nonconductive insulating material suitable for system fluid, pressure, and temperature.
- B. Unions in first paragraph below are available in at least NPS 1/2 to NPS 2 (DN 15 to DN 50).
- C. Dielectric Unions:
  - 1. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers. See Division 01 Section "Product Requirements."
  - 2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. EPCO Sales, Inc.
    - d. Hart Industries International, Inc.
    - e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
    - f. Zurn Plumbing Products Group; Wilkins Water Control Products.
  - 3. Description:
    - g. Pressure Rating: 150 psig at 180 deg F.
    - h. End Connections: Solder-joint copper alloy and threaded ferrous.
- D. Dielectric Flanges:
  - 4. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Capitol Manufacturing Company.
    - b. Central Plastics Company.
    - c. EPCO Sales, Inc.
    - d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
  - 5. Description:
    - e. Factory-fabricated, bolted, companion-flange assembly.
    - f. Pressure Rating: 150 psig.
    - g. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
- E. Dielectric-Flange Kits:
  - 6. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 7. Description:
    - e. Non-conducting materials for field assembly of companion flanges.
    - f. Pressure Rating: 150 psig.
    - g. Gasket: Neoprene or phenolic.
    - h. Bolt Sleeves: Phenolic or polyethylene.
    - i. Washers: Phenolic with steel backing washers.
- F. Dielectric Couplings:
  - 8. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Calpico, Inc.
    - b. Lochinvar Corporation.

- 9. Description:
  - c. Galvanized-steel coupling.
  - d. Pressure Rating: 300 psig at 225 deg F.
  - e. End Connections: Female threaded.
  - f. Lining: Inert and noncorrosive, thermoplastic.
- G. Dielectric Nipples:
  - 10. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Perfection Corporation; a subsidiary of American Meter Company.
    - b. Precision Plumbing Products, Inc.
    - c. Victaulic Company.
  - 11. Description:
    - d. Electroplated steel nipple complying with ASTM F 1545.
    - e. Pressure Rating: 300 psig at 225 deg F.
    - f. End Connections: Male threaded or grooved.
    - g. Lining: Inert and noncorrosive, propylene.

## **2.9 FLEXIBLE CONNECTORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. The VMC Group.
  - 2. Triplex.
  - 3. Mercer Rubber Co.
  - 4. Metraflex, Inc.
- B. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
  - 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
  - 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- C. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
  - 1. Working-Pressure Rating: Minimum 200 psig.
- D. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
- E. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

## **2.10 ESCUTCHEONS**

- A. General: Manufactured ceiling, floor, and wall escutcheons and floor plates.
- B. Split Casting, Cast Brass: Polished, chrome-plated or rough-brass finish with concealed hinge and setscrew.
- C. Split-Casting Floor Plates: Cast brass with concealed hinge.

## **2.11 SLEEVES**

- A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc-coated, with plain ends.

- B. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
  - 1. Underdeck Clamp: Clamping ring with setscrews.

## 2.12 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advance Products & Systems, Inc.
  - 2. Calpico, Inc.
  - 3. Metraflex, Inc.
  - 4. Pipeline Seal and Insulator, Inc.
- B. Description: Modular sealing element unit, designed for field assembly, used to fill annular space between pipe and sleeve.
  - 1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
  - 2. Pressure Plates: Stainless steel.
  - 3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

## 2.13 WALL PENETRATION SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. SIGMA.
- B. Description: Wall-sleeve assembly, consisting of housing and gland, gaskets, and pipe sleeve.
  - 1. Carrier-Pipe Deflection: Up to 5 percent without leakage.
  - 2. Housing: Ductile-iron casting with hub, water stop, anchor ring, and locking devices. Include gland, bolts, and nuts.
  - 3. Housing-to-Sleeve Gasket: EPDM rubber.
  - 4. Housing-to-Carrier-Pipe Gasket: AWWA C111, EPDM rubber.
  - 5. Pipe Sleeve: ASTM A 53/A 53M, Schedule 40, zinc-coated steel pipe.

## PART 3 - EXECUTION

### 3.1 EARTHWORK

- A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

### 3.2 PIPING INSTALLATION

- A. 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.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

- C. 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.
- D. 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.
- E. Wade Shok-stop, 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.
- F. 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.
- G. No underground domestic water piping shall be permitted below the building.
- H. No underground domestic water piping shall be permitted below the building. Looped piping or underfloor shall be Type K copper with no joints (for trap primers and island case work only).
- I. All buried piping shall be buried a minimum of 30" below finished grade including domestic water.
- J. Water lines shall not be run under slab, except for main entry with proper sleeving.
- K. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- L. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- M. Install underground ductile-iron pipe in PE encasement according to ASTM A 674 or AWWA C105.
- N. Building Entrance:
  - 1. Water entry shall be within building Water entry outside of building with a wall penetration above grade is not acceptable.
  - 2. A metallic sleeve shall be inserted in the forms of the building wall through which the water service enters the building. The interior diameter of such sleeve shall be four inches (4") greater than the exterior diameter of the water service.
  - 3. The water service pipe from within the building shall be extended to a point five (5) feet outside the building wall through this sleeve. The position of the water service in this sleeve shall be concentric and the intervening space shall be packed in a flexible manner to avert the flow of water from outside of the building into the basement.
  - 4. The interior pipe extended outside the building shall be provided with a protective wrapping of "Tape Coat" SP warmed with hand torch. This protective tape shall be applied with "half lap" coverage in strict accordance with the manufacturer's published instructions. The cast iron pipe connected to the pipe extending from the building wall shall contain two (2) caulked joints within four feet of the union of the cast iron pipe and the interior pipe from the building.
- O. Connections of dissimilar metal piping shall be made using dielectric fittings.
- P. Install domestic water piping level and plumb.

- Q. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- R. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- S. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.
- T. Install piping adjacent to equipment and specialties to allow service and maintenance.
- U. Install piping to permit valve servicing.
- V. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated. All-thread pipe nipples are not allowed in any piping system. Threaded nipples less than 1/2" in diameter shall be Schedule 80.
- W. Install piping free of sags and bends.
- X. Install fittings for changes in direction and branch connections.
- Y. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- Z. Install pressure gages on suction and discharge piping from each plumbing pump and packaged booster pump. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages.
- AA. Install thermostats in hot-water circulation piping. Comply with requirements of the International Energy Conservation Code.
- BB. Install thermometers on inlet and outlet piping from each water heater. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for thermometers.
- CC. Irrigation Provisions: Furnish and install capped and/or valved water lines under paving, through retaining walls in paved plaza areas and as indicated on Drawings for connections and extensions under work of Section Irrigation (Sprinkler) System.

### **3.3 TESTING AND STERILIZATION**

- A. All water piping systems shall be properly tested to assure their being absolutely leaktight. 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.
- B. The procedure of these tests shall consist of subjecting a piping system to a hydrostatic pressure per Section 23 05 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.

- C. 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 leaktight 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.
- D. 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.
- E. The sterilization process shall be conducted as required by the Health Department of the City of Stafford, Texas 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 Plumbing Subcontractor shall pay all costs and charges incidental to this test and certification.

### **3.4 JOINT CONSTRUCTION**

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints: Join copper tube and fittings according to CDA's "Copper Tube Handbook," "Braze Joints" Chapter.
- E. Soldered Joints: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- A. Steel-Piping Grooved Joints: Roll groove end of pipe. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.
- F. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- G. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

### 3.5 VALVE INSTALLATION

- A. Install shutoff valve accessible from floor, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Meters and Gages for Plumbing Piping" for pressure gages and Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.
- B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Provide shut-off valve for each battery of fixtures located above ceiling near each bathroom.
- A. NPS 1/2 or NPS 3/4 (DN 15 or DN 20) inlet hose-end drain valves may be adequate for application in first paragraph below.
- C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
  - 1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
  - 2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.
- B. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.
- C. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves. Install shutoff valve immediately upstream of each dielectric fitting.
- D. Valve Boxes:
  - 1. For each underground valve installed by the Contractor, the Contractor shall provide and install a two piece, screw adjustable type valve box. These valve boxes shall be designed for heavy roadway service and they shall have a deep socket type of cover which prevents their being accidentally knocked out of position.
  - 2. The word "WATER" shall appear on each cover. The installation of these members shall be such that by the use of the adjustable screw type bodies the tops are just flush with the finished grade. These valve boxes shall be Tyler Pipe Industries #6850, or approved equal.

### 3.6 FLEXIBLE CONNECTOR INSTALLATION

- A. Install flexible connectors in suction and discharge piping connections to each domestic water pump.
- B. Install bronze-hose flexible connectors in copper domestic water tubing.
- C. Install stainless-steel-hose flexible connectors in steel domestic water piping.

### 3.7 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
  - 1. Vertical Piping: MSS Type 8 or 42, clamps.
  - 2. Individual, Straight, Horizontal Piping Runs:

- a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
  - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
  - c. Longer than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- A. Support vertical piping and tubing at base and at each floor.
  - B. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.
  - C. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
    1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
    2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
    3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
    4. NPS 2-1/2: 108 inches with 1/2-inch rod.
    5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
    6. NPS 6: 10 feet with 5/8-inch rod.
  - D. Install supports for vertical copper tubing every 10 feet.

### 3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment and machines to allow service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
  1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
  2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements for plumbing fixture for connection sizes.
  3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

### 3.9 PAINTING

- A. All exposed piping interior and exterior shall be painted. Interior color shall be according to the adopted color codes and shall be appropriately labeled at interviews in specified height letters.
- B. Piping exposed to view shall be painted to comply to Owner approved color scheme.
- C. Piping on roof or building exterior shall be painted with epoxy or polyurethane industrial coating.

### 3.10 IDENTIFICATION

- A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

- B. Label pressure piping with system operating pressure.

### **3.11 FIELD QUALITY CONTROL**

- A. Perform tests and inspections.

- B. Piping Inspections:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
  - a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  - b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Re-inspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for re-inspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

- C. Piping Tests:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 1-1/2 times the working pressure or 150 psig, (whichever is higher) immediately prior to completion without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four (4) hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.
7. Stafford MSD Construction Services Division representative and Architect's/Engineer's representative shall monitor and approve all tests.

- D. Domestic water piping will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

### **3.12 ADJUSTING**

- A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
  - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
  - b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

### 3.13 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
    - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - b. Fill and isolate system according to either of the following:
      - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow it to stand for 24 hours.
      - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow it to stand for three hours.
    - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
    - d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- B. Clean non-potable domestic water piping as follows:
  1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
  2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
    - e. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    - f. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

### 3.14 PIPING SCHEDULE

- E. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- F. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- G. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
  1. Soft copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
  2. Pipe: All pipe used for underground water piping mains from the meter to the point of entry into the building shall be either:

- H. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be the following:
  - 1. Mechanical-joint, ductile-iron pipe; standard-pattern, mechanical-joint fittings; and mechanical joints.
- I. Aboveground domestic water piping, NPS 2 and smaller, shall be the following:
  - 1. Hard copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and soldered joints.
- J. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be one of the following:
  - 1. Hard copper tube, ASTM B88, Type L; cast- or wrought-copper, solder-joint fittings; and brazed joints.
- K. Aboveground domestic water piping, NPS 5 to NPS 8, shall be one of the following:
  - 1. Galvanized-steel pipe; grooved-joint, galvanized-steel-pipe appurtenances; and grooved joints.
  - 2. Stainless-steel Schedule 10 pipe, grooved-joint fittings, and grooved joints.

### **3.15 VALVE SCHEDULE**

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
  - 2. Throttling Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly valves with flanged ends for piping NPS 2-1/2 and larger.
  - 3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
  - 4. Drain Duty: Hose-end drain valves.
- B. Use check valves to maintain correct direction of domestic water flow to and from equipment.
- C. Iron grooved-end valves may be used with grooved-end piping.

**END OF SECTION 22 11 16**

**22 13 16**

**SANITARY WASTE AND VENT PIPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following for soil, waste, and vent piping inside the building:
  - 1. Pipe, tube, and fittings.
  - 2. Special pipe fittings.
  - 3. Encasement for underground metal piping.

**1.3 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.
- C. LLDPE: Linear, low-density polyethylene plastic.
- D. NBR: Acrylonitrile-butadiene rubber.
- E. PE: Polyethylene plastic.
- F. PP: Polypropylene plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. TPE: Thermoplastic elastomer.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

**1.5 SUBMITTALS**

- A. Product Data: For pipe, tube, fittings, and couplings.
- B. Field quality-control inspection and test reports.

## **1.6 QUALITY ASSURANCE**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

## **PART 2 - PRODUCTS**

### **2.1 PIPING MATERIALS**

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### **2.2 PVC PIPE AND FITTINGS**

- A. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-DWV" for plastic drain, waste, and vent piping and "NSF-SEWER" for plastic sewer piping.
- B. Solid-Wall PVC Pipe: Schedule 40 PVC, conform to ASTM D1785 Soil and Waste Vent piping.
- C. PVC Socket Fittings: ASTM D2665, made to ASTM D3311 drain, waste, and vent patterns to fit Schedule 40 with solvent-cemented joints.
- D. Adhesive Primer: ASTM F656.
- E. Solvent Cement: ASTM D2564.

### **1.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A74, Service class.
- B. Gaskets: ASTM C564, rubber.

### **2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS**

- A. Pipe and Fittings: ASTM A888 or CISPI 301.
- B. CISPI, Hubless-Piping Couplings:
  - 1. Standard: ASTM C1277.
  - 1. Description: Two-piece ASTM A48/A48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C564,, rubber sleeve with integral, center pipe stop.
  - 2. Couplings in subparagraph below are available in NPS 1-1/2 to NPS 15 (DN 40 to DN 375) and are economical, but may not be suitable for installation in corrosive soil.
  - 3. Coordinate subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semi-proprietary specifications.
  - 4. Manufacturers:
    - a. ANACO.
    - b. Fernco, Inc.

- c. Ideal Div.; Stant Corp.
- d. Mission Rubber Co.
- e. Tyler Pipe; Soil Pipe Div.

## 2.4 SPECIAL PIPE FITTINGS

- A. Transition Couplings:
  - 1. Manufacturers:
    - a. Dallas Specialty & Mfg. Co.
    - b. Fernco, Inc.
    - c. Logan Clay Products Company (The).
    - d. Mission Rubber Co.
    - e. NDS, Inc.
    - f. Plastic Oddities, Inc.
  - 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
  - 3. Unshielded, Non-pressure Transition Couplings:
    - a. Standard: ASTM C1173.
    - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.
    - c. End Connections: Same size as and compatible with pipes to be joined.
  - 4. Sleeve Materials:
    - a. For Cast-Iron Soil Pipes: ASTM C564, rubber.
    - b. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
    - c. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.
- B. Shielded Non-pressure Transition Couplings:
  - 1. Manufacturers:
    - a. Cascade Waterworks Mfg. Co.
    - b. Mission Rubber Co.
  - 2. Standard: ASTM C1460.
  - 3. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
  - 4. End Connections: Same size as and compatible with pipes to be joined.

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

### 3.2 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
  - 1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  - 2. Hubless cast-iron soil pipe and fittings and CISPI hubless piping couplings; and coupled joints.
- C. Aboveground soil and waste piping NPS 6 and larger shall be the following:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless cast-iron soil pipe and fittings and CISPI hubless piping couplings; and coupled joints.
- D. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Hubless cast-iron soil pipe and fittings and CISPI hub-less piping couplings; and coupled joints.
- E. Underground, soil, waste, and vent piping NPS 6 and smaller shall be any of the following:
1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
  2. Solid-wall, Sewer and Drain Series, Schedule 40 PVC pipe; PVC socket fittings; and solvent-cemented joints. PVC pipe and fittings shall not be used in branch drain lines handling grease waste, hot water discharged from dishwashers, laundry equipment, water heater relief valves, etc.

### 3.3 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Basic piping installation requirements are specified in Division 22.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Cleanouts:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.
  2. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
- K. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."
- L. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A674 or AWWA C105.
- N. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two (2) fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- O. Underground piping shall be bedded in clean bank sand, select fill or cement stabilized sand.
- P. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping or drag in line and pull past each joint as completed.
- Q. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 2 and smaller; 1 percent downward in direction of flow for piping NPS 3 and larger.
  - 2. Horizontal Sanitary Drainage Piping: 1 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- R. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.
- S. Install underground PVC soil and waste drainage piping according to ASTM D2321.
- T. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

### **3.4 JOINT CONSTRUCTION**

- A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."
- B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- C. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
- D. PVC Non-pressure Piping Joints: Join piping according to ASTM D2665.

### **3.5 HANGER AND SUPPORT INSTALLATION**

- A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
  - 1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Install individual, straight, horizontal piping runs according to the following:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    - b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
    - c. Longer than 100 Feet, if indicated: MSS Type 49, spring cushion rolls.
  3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
  4. Base of Vertical Piping: MSS Type 52, spring hangers.
- B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."
- C. Support vertical piping and tubing at base and at each floor.
- D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
- E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6: 60 inches with 3/4-inch rod.
  5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
- F. Install supports for vertical cast-iron soil piping every 15 feet.
- G. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
  2. NPS 3: 48 inches with 1/2-inch rod.
  3. NPS 4 and 5: 48 inches with 5/8-inch rod.
  4. NPS 6: 48 inches with 3/4-inch rod.
  5. NPS 8 to NPS 12: 48 inches with 7/8-inch rod.
- H. Install supports for vertical PVC piping every 48 inches.
- I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### **3.6 CONNECTIONS**

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect drainage and vent piping to the following:
  1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
  2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.

4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

### **3.7 FIELD QUALITY CONTROL**

- B. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- C. Re-inspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for re-inspection.
- D. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- E. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  3. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  4. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  5. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  6. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch W.G.. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  7. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  8. Prepare reports for tests and required corrective action.
  9. Isolate test source and allow to stand for four (4) hours. Leaks and loss in test pressure constitute defects that must be repaired.
  10. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  11. Prepare reports for tests and required corrective action.

### **3.8 CLEANING**

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

**3.9 PROTECTION**

- A. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two (2) coats of water-based UV resistant latex paint.

**END OF SECTION 22 13 16**

**22 40 00**

**PLUMBING FIXTURES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Coordinate with Commissioning Requirements indicated in Section 019100. This contractor is responsible to comply with all requirements for the above section.

**1.2 SUMMARY**

- C. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for lavatories, showers, and sinks.
  - 2. Laminar-flow faucet-spout outlets.
  - 3. Flushometers.
  - 4. Toilet seats.
  - 5. Protective shielding guards.
  - 6. Fixture supports.
  - 7. Water closets.
  - 8. Urinals.
  - 9. Lavatories.
  - 10. Kitchen sinks.
  - 11. Service sinks.
  - 12. Owner-furnished fixtures.

**1.2 DEFINITIONS**

- A. ABS: Acrylonitrile-butadiene-styrene plastic.
- B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- F. FRP: Fiberglass-reinforced plastic.
- G. PMMA: Polymethyl methacrylate (acrylic) plastic.

- H. PVC: Polyvinyl chloride plastic.
- I. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

### **1.3 SUBMITTALS**

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- A. Shop Drawings: Diagram power, signal, and control wiring.
- B. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- C. Warranty: Special warranty specified in this Section.

### **1.3 QUALITY ASSURANCE**

- B. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one (1) source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Regulatory Requirements:
  - 1. Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
  - 2. Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
  - 3. International Plumbing Code, 2015 edition with City of Stafford, Texas amendments.
  - 4. Texas Accessibility Standards (TAS) - Elimination of Architectural Barriers, Texas Government Code, Chapter 469 administered by the Texas Department of Licensing and Regulation (TDLR), effective March 15, 2012.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

### **1.4 WARRANTY**

- A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Structural failures of unit shell.

- b. Faulty operation of controls, blowers, pumps, heaters, and timers.
- c. Deterioration of metals, metal finishes, and other materials beyond normal use.

#### **1.4 MAINTENANCE**

- A. Provide twelve (12) months maintenance of all materials and equipment under this section. Cost of the twelve (12) month normal and preventive maintenance shall be included within this scope of work.

### **PART 2 - PRODUCTS**

#### **2.1 LAVATORY FAUCETS**

- A. Lavatory Faucets: Lavatory faucets shall be metered, push type.
  - 1. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:
    - a. Chicago.
    - b. Delta
    - c. Symmons.
- B. Lavatory faucet supplies: 3/8" chrome plated copper attached to a 1/2" IPS x 3/8" flare chrome plated loose-key stop. All exposed chrome plated fittings polished.

#### **2.2 SINK FAUCETS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Elkay, Inc.
  - 2. Chicago Faucets.
  - 3. Moen, Inc.
  - 4. Just Manufacturing Company.
  - 5. Kohler Co.
- B. Description: Refer to Plumbing Fixture Schedule on the Drawings..

#### **2.3 FLUSHOMETERS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Sloan Valve Company
  - 2. Toto.
- B. Description: Refer to Plumbing Fixture Schedule on the Drawings.

#### **2.4 TOILET SEATS**

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Bemis Manufacturing Company.
  - 2. Benke.
- B. Description: Refer to Plumbing Fixture Schedule on the Drawings.

## 2.5 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Josam Company.
  2. MIFAB Manufacturing Inc.
  3. Smith, Jay R. Mfg. Co.
  4. Tyler Pipe; Wade Div.
  5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
  6. Zurn Plumbing Products Group; Specification Drainage Operation.
- B. Water-Closet Supports:
1. Description: Combination carrier designed for accessible standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
- C. Urinal Supports:
1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture II, urinal carrier with hanger and bearing plates for wall-mounting, urinal-type fixture. Include steel uprights with feet.
  2. Accessible-Fixture Support: Include rectangular steel uprights.
- D. Lavatory Supports:
1. All wall hung lavatories shall have carriers.
  2. Description:
    - a. Type I, lavatory carrier with exposed arms and tie rods
    - b. Type II, lavatory carrier with concealed arms and tie rod
    - c. Type III, lavatory carrier with hanger plate and tie rod for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
  3. Accessible-Fixture Support: Include rectangular steel uprights.
- E. Sink Supports:
1. All wall hung sinks shall have carriers.
  2. Description: Type I, sink carrier with exposed arms and tie rods II, sink carrier with hanger plate, bearing studs, and tie rod III, sink carrier with hanger plate and exposed arms for sink-type fixture. Include steel uprights with feet.

## 2.6 WATER CLOSETS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. American Standard Companies, Inc.
  2. Kohler Co.
  3. Toto.
- B. Description: Refer to Plumbing Fixture Schedule on the Drawing.

## 2.7 URINALS

- A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Standard Companies, Inc.
2. Kohler Co.
3. Toto

B. Description: Wall hung vitreous china, siphon jet type, flush valve actuated with Sloan-Royal / Regal manually operated flush valve only with vacuum breaker and screwdriver stop, piped to the right-hand side, according to National Plumbing Code. (All wall hung fixtures shall have chair carriers)..

1. Type: Blowout Siphon jet Blowout with extended shields Siphon jet with extended shields Washout with extended shields.
2. Strainer or Trap way: Integral cast strainer Separate removable strainer Open trap way with integral trap.
3. Design Consumption: 0.5gal. /flush.
4. Color: White.

## **2.8 LAVATORIES**

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Standard Companies, Inc.
- 2.
3. Kohler Co.
4. Toto

B. Description: Refer to Plumbing Fixture Schedule on the Drawing.

## **2.9 COMMERCIAL SINKS**

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, the following:

1. Elkay Manufacturing Co.
2. Just Manufacturing Company.
3. Moen

B. Description: Refer to Plumbing Fixture Schedule on the Drawing.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.
- B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### **3.2 INSTALLATION**

- A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.
- B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
  2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
  3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.
- D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.
- E. Install wall-mounting fixtures with tubular waste piping attached to supports.
- F. Install floor-mounting, back-outlet water closets attached to building floor substrate and wall bracket and onto waste fitting seals.
- G. Install counter-mounting fixtures in and attached to casework.
- H. Install fixtures level and plumb according to roughing-in drawings.
- I. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- L. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.
- M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
- N. Install toilet seats on water closets.
- O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
- R. Install traps on fixture outlets.
1. Exception: Omit trap on fixtures with integral traps.
  2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- S. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

- T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."
- U. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

### **3.3 CONNECTIONS**

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

### **3.4 FIELD QUALITY CONTROL**

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.
- E. Install fresh batteries in sensor-operated mechanisms.

### **3.5 ADJUSTING**

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Operate and adjust disposers hot-water dispensers and controls. Replace damaged and malfunctioning units and controls.
- C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.
- D. Replace washers and seals of leaking and dripping faucets and stops.
- E. Install fresh batteries in sensor-operated mechanisms.

### **3.6 CLEANING**

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
  - 2. Remove sediment and debris from drains.

- B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

**3.7 PROTECTION**

- A. Provide protective covering for installed fixtures and fittings.
- B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

**END OF SECTION 22 40 00**

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**COMMON WORK RESULTS IN HVAC**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Coordinate with Commissioning Requirements indicated in Section 019113. This Contractor is responsible to comply with all requirements for the above section.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Mechanical sleeve seals.
  - 5. Sleeves.
  - 6. Escutcheons.
  - 7. Grout.
  - 8. HVAC demolition.
  - 9. Equipment installation requirements common to equipment sections.
  - 10. Painting and finishing.
  - 11. Concrete bases.
  - 12. Supports and anchorages.

**1.3 DEFINITIONS**

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
  - 1. CPVC: Chlorinated polyvinyl chloride plastic.

2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: Include Products specified in the following Sections:
1. Section 23 05 93 – Testing, Adjusting and balancing
  2. Section 23 31 13 – Metal Ducts
  3. Section 23 33 00 – Ductwork Accessories
  4. Section 23 37 00 – Air Inlets and Outlets
- B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.
- C. Mark dimensions and values in units to match those specified.
- D. 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.
- E. 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.

#### 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
  2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.
- D. All equipment and materials shall be new, unused and of United States Domestic manufacture.

## **1.6 DELIVERY, STORAGE, AND HANDLING**

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

## **1.7 COORDINATION**

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
- D. Prepare Coordination / Installation Shop drawings to a scale of 1/4"=1'0" or larger; detailing major elements, components, and systems of mechanical equipment and materials in relationship with other systems, installations, and building components. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the Work, including (but not necessarily limited to) the following:
  - 1. Structural floor, wall and roof opening sizes and details
  - 2. Clearances for installing and maintaining insulation.
  - 3. Locations of light fixtures and sprinkler heads.
  - 4. Clearances for servicing and maintaining equipment, including tube removal, filter removal, and space for equipment disassembly required for periodic maintenance.
  - 5. Equipment connections and support details.
  - 6. Exterior wall and foundation penetrations.
  - 7. Routing of piping and ductwork.
  - 8. Fire rated wall and floor penetrations.
  - 9. Sizes and location of required concrete pads and bases.

## **1.8 APPLICABLE CODES AND STANDARDS**

- A. Obtain all required permits and inspections for all work required by the Contract Documents and pay all required fees in connection thereof.
- B. Arrange with the serving utility companies for the connection of all required utilities and pay all charges, meter charges, connection fees and inspection fees, if required.
- C. Comply with all applicable codes, specifications, local ordinances, industry standards, utility company regulations and the applicable requirements of the following nationally accepted codes and standards:
  - 1. Underwriters' Laboratories, Inc., UL.
  - 2. Air Moving & Conditioning Association, AMCA.
  - 3. American Standards Association, ASA.
  - 4. American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc., ASHRAE.
  - 5. American Society of Mechanical Engineers, ASME.

6. American Society of Testing Materials, ASTM.
7. American Water Works Association, AWWA.
8. International Energy Conservation, Mechanical and Fuel Gas Codes, 2015 edition with City of Stafford, Texas amendments.
9. National Bureau of Standards, NBS.
10. National Fire Protection Association, NFPA.
  - a. NFPA 70, National Electrical Code, 2017 edition with City of Stafford, Texas amendments.
11. Sheet Metal & Air Conditioning Contractors' National Association, SMACNA.
12. 2012 Texas Accessibility Standards, effective March 15, 2012.

- D. Where differences existing between the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, the more stringent or costly application shall govern. Promptly notify the Engineer in writing of all differences.
- E. When directed in writing by the Engineer, remove all work installed that does not comply with the Contract Documents and applicable state or city building codes, state and local ordinances, industry standards, utility company regulations and the applicable requirements of the above listed nationally accepted codes and standards, correct the deficiencies, and complete the work at no additional cost to the Owner.

#### **1.9 DRAWINGS & SPECIFICATIONS**

- A. These Specifications are intended to supplement the Drawings and it will not be the province of the Specifications to mention any part of the work which the Drawings are competent to fully explain in every particular and such omission is not to relieve the Contractor from carrying out portions indicated on the Drawings only.
- B. Should items be required by these Specifications and not indicated on the Drawings, they are to be supplied even if of such nature that they could have been indicated thereon. In case of disagreement between Drawings and Specifications, or within either Drawings or Specifications, the better quality or greater quantity of work shall be estimated and the matter referred to the Architect or Engineer for review with a request for information and clarification at least 7 working days prior to bid opening date for issuance of an addendum.
- C. The listing of product manufacturers, materials and methods in the various sections of the Specifications, and indicated on the Drawings, is intended to establish a standard of quality only. It is not the intention of the Owner or Engineer to discriminate against any product, material or method that is equal to the standards as indicated and/or specified, nor is it intended to preclude open, competitive bidding. The fact that a specific manufacturer is listed as an acceptable manufacturer should not be interpreted to mean that the manufacturers' standard product will meet the requirements of the project design, Drawings, Specifications and space constraints.
- D. The Architect or Engineer and Owner shall be the sole judge of quality and equivalence of equipment, materials and methods.
- E. Products by other reliable manufacturers, other materials, and other methods, will be accepted as outlined, provided they have equal capacity, construction, and performance. However, under no circumstances shall any substitution be made without the written permission of the Architect or Engineer and Owner. Request for prior approval must be made in writing 10 days prior to the bid date without fail.

- F. Wherever a definite product, material or method is specified and there is not a statement that another product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method is the only one that shall be used without prior approval.
- G. Wherever a definite material or manufacturer's product is specified and the Specification states that products of similar design and equal construction from the specified list of manufacturers may be substituted, it is the intention of the Owner or Engineer that products of manufacturers that are specified are the only products that will be acceptable and that products of other manufacturers will not be considered for substitution without approval.
- H. Wherever a definite product, material or method is specified and there is a statement that "OR EQUAL" product, material or method will be acceptable, it is the intention of the Owner or Engineer that the specified product, material or method or an "OR EQUAL" product, material or method may be used if it complies with the specifications and is submitted for review to the Engineer as outline herein. Where permission to use substituted or alternative equipment on the project is granted by the Owner or Engineer in writing, it shall be the responsibility of the Contractor or Subcontractor involved to verify that the equipment will fit in the space available which includes allowances for all required Code and maintenance clearances, and to coordinate all equipment structural support, plumbing and electrical requirements and provisions with the Mechanical (HVAC) and Plumbing Design Documents and all other trades.
- I. Coordinate with Division 01 requirements for substitution, unless noted otherwise the Contractors wishing to substitute products, materials or methods from those indicated or specified, shall submit such requests to the Owner or Engineer in writing and within THIRTY (30) WORKING DAYS OF NOTIFICATION OF CONTRACT AWARD. Requests for permission to utilize alternates or substitutions will not be considered after that time, unless the Specified item is unavailable or will adversely affect the completion of the Project. Claims submitted for consideration will require notarized letters from all parties involved and will be considered only if the Contractor has been timely in his delivery for review of all required equipment and material submittals. Owner or Engineer will investigate such requests for substitution and if acceptable will issue a letter allowing the substitution.
- J. If any request for a substitution of product, material or method is rejected, the Contractor will automatically be required to furnish the product, material or method named in the Specifications. Repetitive requests for substitutions will not be considered.
- K. Requests shall be bound and shall consist of three (3) sets of descriptive literature and performance data covering each item of equipment or material. The submittal shall include the following:
1. Manufacturer's name and phone number
  2. Name of the person submitting the product
  3. Model number
  4. Performance
  5. Statement of compliance with specification.
  6. Name of the individuals or company originating the submittal.
  7. Name of the project for which the submittal is made.
  8. An index page of the items submitted.
  9. A written list of variations between the specified product and the submitted product.
  10. Sufficient information, including scaled drawing of area and equipment involved at a scale of 1/4" = 1'-0" minimum, as required to demonstrate that the alternate or substituted product will fit in the space available.

11. Identification of each item of material or equipment matching that indicated on the Drawings. All applicable industry or national Listings, Labels, Approvals and Standards shall be clearly indicated.
  12. Sufficient pictorial, descriptive and diagrammatic data on each item to show its conformance with the Drawings and Specifications. Any options or special requirements shall be so indicated. All non-applicable information shall be crossed out.
  13. Provide upon request of the Owner or Engineer, samples of materials and/or equipment as may be required.
- L. The Owner or Engineer will investigate all requests for substitutions when submitted in accordance with above and if accepted, will issue a letter allowing the substitutions. The Engineer shall be the sole authority to approve or disapprove any and all substitutions.
- M. Where equipment other than that used in the design as specified or shown on the Drawings is substituted (either from an approved manufacturers list or by submittal review), it shall be the responsibility of the substituting Contractor to coordinate space requirements, building provisions and connection requirements with his trades and all other trades and pay all additional costs to other trades, the Owner, the Architect or Engineer, if any, due to the substitutions.

#### **1.10 RECORD DOCUMENTS**

- A. Prepare Record Documents in accordance with the requirements in Special Project Requirements, in addition to the requirements specified in Division 23, indicate the following installed conditions.
1. Duct mains and branches, size and location, for both exterior and interior; locations of dampers, fire dampers, duct access panels, and other control devices; filters, fuel fired heaters, fan coils, condensing units, and roof-top A/C units requiring periodic maintenance or repair.
  2. Mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e., traps, strainers, expansion compensators, tanks, etc.). Valve location diagrams, complete with valve tag chart. Indicate actual inverts and horizontal locations of underground piping.
  3. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  4. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
  5. Contract Modifications, actual equipment and materials installed.
- B. The Contractor shall maintain a set of clearly marked black line record "AS-BUILT" prints on the job site on which he shall mark all work details, alterations to meet site conditions and changes made by "Change Order" notices. These shall be kept available for inspection by the Owner, Architect or Engineer at all times.
- C. Contractor Startup and Commissioning Verification - the system will provide a secure page for each integrated system allowing the contractor responsible for each phase to sign on and certify the status of each piece of equipment.
- D. Refer to Division 01 for additional requirements concerning record drawings. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect. Mark the drawings with a colored pencil. Delivery of as built prints and re-producible is a condition of final acceptance.

- E. The record prints shall be updated on a daily basis and shall indicate accurate dimensions for all buried or concealed work, precise locations of all concealed pipe or duct, locations of all concealed valves, controls and devices and any deviations from the work shown on the Construction Documents which are required for coordination. All dimensions shall include at least two dimensions to permanent structure points.
- F. At the Engineer's option, the Contractor shall transfer all data from the record "AS-BUILT" prints to an electronic media such as AutoCAD latest release, in order to plot the reproducible media "AS-BUILT" drawings. Since data stored on electronic media can deteriorate undetected or be modified without the Engineer's knowledge, the AutoCAD electronic drawing files are provided without warranty or obligation on the part of the Engineer as to accuracy or information contained in the files. All information in the files shall be independently verified by the user. Any user shall agree to indemnify and hold the Engineer harmless from any and all claims, damages, losses, and expenses including but not limited to Attorney's fees arising out of the use of the AutoCAD drawing files. Engineer shall furnish to the Contractor electronic media files of Contract Documents for the Contractor to use for inputting of the data from the record "AS-BUILT" prints and the Contractor shall return the revised electronic files on CD ROM properly labeled to the Engineer and shall submit the plotted reproducible drawings and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineers Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet as described in paragraph G. below.
- G. Contractor shall transfer all marks from record drawings and submit a set of clear concise set of reproducible record "AS-BUILT" drawings and shall submit the reproducible drawings with corrections made by a competent draftsman and three (3) sets of black line prints to the Architect or Engineer for review prior to scheduling the final inspection at the completion of the work. The reproducible record "AS-BUILT" drawings shall have the Engineer's Name and Seal removed or blanked out and shall be clearly marked and signed on each sheet.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

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

### **2.2 PIPE, TUBE, AND FITTINGS**

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

### **2.3 JOINING MATERIALS**

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
  - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

- a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
  - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
  2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

#### **2.4 TRANSITION FITTINGS**

- A. Plastic-to-Metal Transition Fittings: PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one (1) end with threaded brass insert, and one (1) solvent-cement-joint end.
1. Manufacturers:
    - a. Eslon Thermoplastics.
- B. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
1. Manufacturers:
    - a. Thompson Plastics, Inc.
- C. Plastic-to-Metal Transition Unions: MSS SP-107, PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
1. Manufacturers:
    - a. NIBCO INC.
    - b. NIBCO, Inc.; Chemtrol Div.

#### **2.5 DIELECTRIC FITTINGS**

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Eclipse, Inc.
    - d. EpcO Sales, Inc.
    - e. Hart Industries, International, Inc.

- f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- 1. Manufacturers:
    - a. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Epco Sales, Inc.
    - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
- 1. Manufacturers:
    - a. Advance Products & Systems, Inc.
    - b. Calpico, Inc.
    - c. Central Plastics Company.
    - d. Pipeline Seal and Insulator, Inc.
  - 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
    - a. Calpico, Inc.
    - b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
- 1. Manufacturers:
    - a. Perfection Corp.
    - b. Precision Plumbing Products, Inc.
    - c. Sioux Chief Manufacturing Co., Inc.
    - d. Victaulic Co. of America.

## 2.6 MECHANICAL SLEEVE SEALS

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

## **2.7 SLEEVES**

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
- E. Underdeck Clamp: Clamping ring with set screws.
- F. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- G. PVC Pipe: ASTM D1785, Schedule 40.
- H. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

## **2.8 ESCUTCHEONS**

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

## **2.9 GROUT & FOUNDATION**

- A. Description: ASTM C1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
  - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
  3. Packaging: Premixed and factory packaged.
- B. Foundations and pads shall be constructed of reinforced concrete and shall be sized and reinforced as noted or detailed on the Drawings. As a minimum, pads shall be 6" thick, by width and length as required by item it is under, reinforced with 6 x 6 W2.9 x W2.9 Welded Wire mesh.
- C. Support attachments, unless otherwise noted on shown, shall be securely attached to the item's foundation, pad or building structure, per manufacturers recommendations and shall be approved by the Architect.

### **PART 3 - EXECUTION**

#### **3.1 PIPING SYSTEMS - COMMON REQUIREMENTS**

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
  1. New Piping:
    - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
    - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
    - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
    - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
  - f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
  - g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
  - h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
  - i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
  - j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
  - k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
  - l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
  - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
  - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
    - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
    - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
    - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
    - d. Seal space outside of sleeve fittings with grout.
  - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- 1. Install steel pipe for sleeves smaller than 6 inches in diameter.
  - 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
  - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
  - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

### **3.2 PIPING JOINT CONSTRUCTION**

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### **3.3 PIPING CONNECTIONS**

- A. Make connections according to the following, unless otherwise indicated:
  - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### **3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS**

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.
- E. Coordinate setting of equipment with the requirements of other trades so as to avoid conflicts and to insure compatibility. Equipment shall not block access for installation of other equipment.
- F. Set base mounted equipment on permanent and finished supports. Temporary support, if any, shall be removed prior to making final pipe, duct, or electrical connections to equipment.
- G. Adjust suspended equipment to final elevation prior to making pipe, duct or electrical connections.
- H. Exercise caution during equipment placing operations to ensure that structure is not overloaded.
- I. Do not move heavy equipment across floor or roof of insufficient load bearing capacity to support such equipment. Provide bracing or shoring as required, or use crane to place equipment directly on permanent and finished support.
- J. All exterior mechanical appliances and equipment that are exposed to wind, including package units, condensing units, fans, equipment casings, rooftop units, hold-downs, curbs, etc., (whether integral or loose), shall be designed and installed to resist wind pressures in accordance with the IBC wind load zone designated for the project. Provide calculations signed and sealed by a Texas licensed professional engineer establishing wind velocity pressure values for the specific project in accordance with ASCE-7 adopted by the IBC applicable to the project.
  1. Ultimate Wind Speed: 147 mph, 3-second gust.
  2. Exposure: B.
  3. Risk Category: III.

### **3.5 PAINTING**

- A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

### **3.6 CONCRETE BASES**

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
  - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
  - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
  - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
  - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
  - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
  - 7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete Miscellaneous Cast-in-Place Concrete."

### **3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES**

- A. Refer to Division 05 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

### **3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES**

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor HVAC materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

### **3.9 GROUTING**

- A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.

- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

**END OF SECTION 23 05 00**

**23 05 93**

**SYSTEM TESTING, ADJUSTING AND BALANCING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Contract Documents, General Requirements for Building Construction and Related Work, apply to work specified in this section.
- B. Coordinate with Commissioning Requirements indicated in Section 017500 – “Starting and Adjusting”. This Contractor is responsible to comply with all requirements for the above section.

**1.2 SCOPE**

- A. Testing, Adjusting and Balancing (TAB) contractor shall bid work specified under this section direct to school district. TAB Contractor shall not be hired by General Contractor or any subcontractor. Mechanical Contractor shall provide all assistance and information requested by the TAB Contractor.
- B. This Section provides for the testing and balancing, of all systems and equipment. Refer to Section 23 08 00 for commissioning requirements.
- C. These tests are required to determine that all systems and equipment involved may be safely energized and equipment.
- D. Perform tests by and under the supervision of fully experienced and qualified personnel. Advise each respective manufacturer’s representative of tests on their equipment.
- E. Record all test data.
- F. Each section of Division 23 that has the products or systems listed herein, incorporate this section by reference and is incomplete without the required tests stated herein.
- G. This Section includes testing, adjusting, balancing HVAC systems and alarm point reporting verification to produce design objectives, including the following:
  - 1. Balancing airflow and water flow within distribution systems, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
  - 2. Adjusting total HVAC systems to provide indicated quantities.
  - 3. Measuring electrical performance of HVAC equipment.
  - 4. Testing, adjusting, and balancing of Hydraulic piping systems.
  - 5. Testing, adjusting, and balancing of refrigerating systems.
  - 6. Measurement of final operating condition of HVAC systems.
  - 7. Sound measurement of equipment operating conditions.
  - 8. Setting quantitative performance of HVAC equipment.
  - 9. Verifying that automatic control devices are functioning properly and perform their intended functions.
  - 10. Calibrating automatic temperature control sensors.
  - 11. Verification of building alarm and alarm remote monitoring.

## 1.2 QUALIFICATIONS

- A. The independent testing, adjusting, and balancing agency certified by National Environmental Balancing Bureau (NEBB) or by the Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project, and having at least one Professional Engineer registered in the State in which the services are to be performed, certified by NEBB or AABC as a Test and Balance Engineer.
- B. The TAB 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 TAB 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 (5) 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.
- F. Pre-Balancing Conference: Prior to beginning of testing, adjusting, and balancing procedures, schedule and conduct a conference with the Engineer and representatives of installers of the mechanical systems. The objective of the conference is final coordination and verification of the system operation and readiness for testing, adjusting, and balancing.
- G. Test, adjust, and balance the air systems before hydronic and refrigerant systems.
- H. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within five degrees Fahrenheit (5 deg-F) wet bulb temperature of maximum summer design condition, and within ten degrees Fahrenheit (10 deg-F) dry bulb temperature of minimum winter design condition. Take final temperature reading during seasonal operation.
- I. Approved TAB Contractors:
  - 1. Engineered Air Balance.
  - 2. National Precisionaire, LLC.

## 1.3 SERVICES OF THE MECHANICAL CONTRACTOR

- A. Mechanical Contractor is responsible for coordinating work with the TAB Contractor. Mechanical contractor requirements are specified herein.

- B. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm.
- C. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project.
- D. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, Contractor shall provide belt and sheave adjustment such that units deliver their design CFM when speed drive is at 60 hertz.
- H. The General Contractor and appropriate sub-contractors shall turn over the completed job to the TAB Contractor before testing begins. The General Contractor shall ensure the system is fully operational, has been cleaned and new air filters installed in all air-handling units prior to requesting the TAB Contractor to perform his work
- J. Verify systems are complete and operable before commencing work. Verify the following:
  - 1. Systems are started and operating in safe and normal condition.
  - 2. Temperature control systems are installed complete and operable.
  - 3. Proper thermal overload protection is in place for electrical equipment.
  - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  - 5. Duct systems are clean of debris.
  - 6. Fans are rotating correctly.
  - 7. Fire and volume dampers are in place and open.
  - 8. Air coil fins are cleaned and combed.
  - 9. Access doors are closed and duct end caps are in place.
  - 10. Air outlets are installed and connected.
  - 11. Duct system leakage is minimized.
  - 12. Re-sheave.
- I. It shall be the responsibility of the General Contractor and appropriate sub-contractors to cooperate with the Owner's TAB Contractor in furnishing personnel during the test and balancing to make such adjustments and corrections specified by the TAB, including but not limited to sheave changes.

### **1.3 REPORTS**

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

- C. Submit test report forms for review a minimum of thirty (30) days prior to requesting a final review by the Architect/ Engineer.
- D. Furnish six (6) individually bound copies of test data. 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 take, both prior to and after any corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation.
- E. The Architect will retain on (1) copy and the Engineer will retain one (1) copy. The remaining four (4) copies will be returned to the Contractor for inclusion in the operation and maintenance manuals. Refer to Division 01 – Closeout Submittals.

#### **1.4 REFERENCES**

- A. AABC - National Standards for Total System Balance, 7th edition, 2016.
- B. ASHRAE 111-2008 (RA2017) - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
- C. IMC – International Mechanical Code, 2015 edition with City of Stafford, Texas amendments.
- D. NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

#### **1.4 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 Standards.
- B. Liaison and Early Inspection:
  - 1. The TAB firm personnel shall support on the job the commissioning authority responsible to 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 balance ability and provide commentary.
    - b. During construction, review all HVAC submittals such as control diagrams, air handling devices, etc., that pertain to commissioning work and balance ability.
    - 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 Owner's Designated Representative of each observation.
  - 1. 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.

### 1.5 VIBRATION TESTS

- A. Location of Points for Air Handling Unit Fans and all other Fans:
  - 1. Fan bearing, drive end.
  - 2. Fan bearing, opposite end.
  - 3. Motor bearing, center (if applicable)
  - 4. Motor bearing, drive end.
  - 5. Motor bearing, opposite end.
- B. Test Readings.
  - 1. Horizontal, velocity and displacement.
  - 2. Vertical, velocity and displacement.
  - 3. Axial, velocity and displacement.
- C. Normally acceptable readings, velocity and acceleration.
- D. Unusual conditions at time of test.
- E. Vibration sources (if non-complying)

### 1.6 FINAL AIR BALANCE

- A. 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 +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 airflow on terminal boxes.

### **1.7 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.

### **1.8 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 and other controlled devices are operated by the intended controller.
  4. Verify that all dampers are in the position indicated by the controller (open, closed or modulating).
  5. Verify the integrity of 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 the calibration of all controllers.
  7. Observe the locations of all thermostats and humidistats for potential erratic operation from outside influences such as sunlight, drafts or cold walls.
  8. 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.
  9. 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.
  10. Verify that all controller setpoints meet the design intent.
  11. Check all dampers for free travel.
  12. Verify the operation of all interlock systems.

13. 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.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 SERVICES OF THE MECHANICAL CONTRACTOR**

- A. Examine the contract documents to become familiar with Project requirements and to discover conditions in systems design that may preclude proper TAB of systems and equipment.
- B. Examine the approved submittals for HVAC systems and equipment.
- C. Verify systems are complete and operable before commencing work. Verify the following:
  1. Systems are started and operating in safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fans are rotating correctly.
  7. Fire and volume dampers are in place and open.
  8. Air coil fins are cleaned and combed.
  9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Duct system leakage is minimized.
  12. Re-sheave.
- D. Contractor shall provide all volume dampers, balancing dampers, balancing valves, test ports and Pete's plugs as required by the Testing and Balancing Firm. Contractor shall furnish a set of sheet metal shop drawings and HVAC piping drawings to the Testing and Balancing Firm during the submittal phase and incorporate the Testing and Balancing Firm's mark-ups and requests into the project. Contractor shall provide all required equipment to facilitate Testing and Balancing Firm's work. This coordination shall be included in the Contractor's base bid price.
- E. Provide, correct, repair or replace deficient items or conditions found during the testing and balancing.
- F. Provide replacement sheaves as directed by TAB Contractor to achieve scheduled air volumes.
- G. For motors with a variable frequency drive, contractor shall provide belt and sheave adjustment such that units deliver their design cfm when speed drive is at 60 hertz.

### **3.2 SERVICES OF THE TESTING AND BALANCING CONTRACTOR**

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.
- C. Complete system-readiness checks and prepare reports. Verify the following:

1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
6. Windows and doors can be closed so indicated conditions for system operations can be met.

### **3.3 INSTALLATION TOLERANCES**

- A. Set HVAC system's air flow rates and water flow rates within the following tolerances:
  1. Supply, Return, and Exhaust fans and Equipment with Fans: +/- 5%
  2. Air Outlets and Inlets: +/- 5%

### **3.4 ADJUSTING**

- A. Verify recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of dampers and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- D. Report defects and deficiencies noted during performance of services, preventing system balance.
- E. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### **3.5 PREPARATION**

- A. Follow industry standard practices and procedures for testing, balancing, as listed in Part 1 of this Section.
- B. The A/E must be notified a minimum of 72 hours prior to any tests being conducted.
- C. The TAB Contractor must be notified a minimum of five (5) working days prior to conduction any duct leakage tests and same must be present to witness all duct leakage tests.

### **3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS**

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities.
- B. Make air quantity measurements in main ducts by pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches W.G. positive static pressure near building entries in clean rooms.

### **3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS**

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
  - 1. Measure total airflow.
    - a. Where sufficient space in ducts is unavailable for pitot tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
    - b. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - c. Measure static pressure directly at the fan outlet or through the flexible connection.
    - d. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - e. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
    - b. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
    - c. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
    - d. Obtain approval from Construction Manager for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in HVAC Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
    - e. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure

amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, sub-main ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of sub-main and branch ducts.
  - 2. Where sufficient space in sub-main and branch ducts is unavailable for pitot tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  - 3. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  - 4. Re-measure each sub-main and branch duct after all have been adjusted. Continue to adjust sub-main and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
  - 1. Measure air outlets and inlets without making adjustments.
- D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
  - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
  - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### **3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS**

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
  - 1. Set outdoor-air dampers at minimum and set return- and exhaust-air dampers at a position that simulates full-cooling load.
  - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
  - 3. Measure total system airflow. Adjust to within indicated airflow.
  - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
  - 6. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  - 7. Re-measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.

8. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
9. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
10. Record final fan-performance data.

### **3.9 PROCEDURES FOR MOTORS**

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
  1. Manufacturer's name, model number, and serial number.
  2. Motor horsepower rating.
  3. Motor rpm.
  4. Efficiency rating.
  5. Nameplate and measured voltage, each phase.
  6. Nameplate and measured amperage, each phase.
  7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

### **3.10 MECHANICAL EQUIPMENT**

- A. Verify the following:
  1. Equipment is operable and in safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Correct fan rotation.
  7. Fire and volume dampers are in place and open.
  8. Coil fins have been cleaned and combed.
  9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and operable.
  11. Duct system leakage has been minimized.
  12. Pretest components in the VFD. Provide factory certification of testing the entire VFD with varying induction motor loads for 24 hours prior to shipment.
  13. Proper sequencing and operation of all DDC Control System components and equipment as required by ASHRAE Standard on Total Building Mechanical System operation.
  14. Perform sound power level tests and provide required data on each occupied space adjacent to, above, or below mechanical/ air handling unit equipment rooms.
  15. Perform vibration test and provide required data on each piece of air handling/ ventilation equipment or fan. Vibration testing must be complete in compliance with the requirements of ASHRAE – 1999 HVAC applications Handbook Chapter 46, Sound and Vibration Control and the maximum listed RMS values listed herein.
- B. Duct Leakage:
  1. Test all supply air ductwork, to include, but not limited to, downstream of all single zone and multi-zone air handling units, downstream of all VAV air handling units and upstream of fan powered terminal units at 2-1/2 inches of static pressure (except where this

- requirement would exceed the ductwork design pressure classification) to have a total leakage value not to exceed 2% of the total system airflow.
2. Test all supply, return, and exhaust air ductwork, to include, but not limited to, downstream of fan coil units and fan powered terminal units, upstream of air handling units, and upstream and downstream (where applicable) of fans at 1-1/2 inches of static pressure to have a total leakage value not to exceed 2% of the total system design airflow.
  3. Ductwork that initially fails these tests shall be replaced, modified, resealed, etc. as required to meet the leakage requirement and then re-tested to ensure compliances.

### 3.11 FINAL TAB REPORT

- A. General: The activities described in this section shall culminate in a certified final written report to be provided in quadruplicate (4) individually bound to the RCM. Tabulate and divide the report into separate sections for tested systems and balanced systems..
  1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instruments used and list all measurements taken after all corrections are made to the system.
    1. 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.
    2. 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.
    3. 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.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  1. Fan curves.
  2. Manufacturers' test data.
  3. Field test reports prepared by system and equipment installers.
  4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: 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 Architect
    - h. Project Engineer
    - i. Project Contractor's Name and Address
    - j. Project Identification Number
    - k. Report date.
    - l. Signature of TAB supervisor who certifies the report.
  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)
  - f. Location
  - g. Manufacturer
  - h. Model
  - i. Air flow, specified and actual
  - j. Total static pressure (total external), specified and actual
  - k. Inlet pressure
  - l. Discharge pressure
  - m. 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
  - e. Return air temperature
  - f. Outside air temperature
  - g. Required mixed air temperature
  - h. 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 Monitoring Station Data
  - a. Identification/location
  - b. System
  - c. Size
  - d. Area

- e. Design velocity
- f. Design air flow
- g. Test velocity
- h. Test air flow
- 9. 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
  - j. Pump Data
  - k. Identification/number
  - l. Manufacturer
  - m. Size/model
  - n. Impeller
  - o. Service
  - p. Design flow rate, pressure drop, BHP
  - q. Actual flow rate, pressure drop, BHP
  - r. Discharge pressure
  - s. Suction pressure
  - t. Total operating head pressure
  - u. Shut off, discharge and suction pressure
  - v. Shut off, total head pressure
  - w. Pressure differential settings
- 10. Cooling Coil Data
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Entering air DB temperature, design and actual
  - f. Entering air WB temperature, design and actual
  - g. Leaving air DB temperature, design and actual
  - h. Leaving air WB temperature, design and actual
  - i. Air pressure drop, design and actual
- 11. Heating Coil Data
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Entering air temperature, design and actual
  - g. Leaving air temperature, design and actual
  - h. Air pressure drop, design and actual
- 12. Sound Level Report
  - a. Location (Location established by the design engineer)
  - b. NC curve for eight (8) bands - equipment off
  - c. NC curve for eight (8) bands - equipment on
- 13. Vibration Test on equipment having 10 HP motors or above
  - a. Location of points:
    - 1) Fan bearing, drive end

- 1) Fan bearing, opposite end
  - 2) Motor bearing, center (if applicable)
  - 3) Motor bearing, drive end
  - 4) Motor bearing, opposite end
  - 5) Casing (bottom or top)
  - 6) Casing (side)
  - 7) Duct after flexible connection (discharge)
  - 8) Duct after flexible connection (suction)
  - b. Test readings:
    - 9) Horizontal, velocity and displacement
    - 10) Vertical, velocity and displacement
    - 11) Axial, velocity and displacement
  - c. Normally acceptable readings, velocity and acceleration
  - d. Unusual conditions at time of test
  - e. Vibration source (if non-complying)
14. Control verification indicating date performed and any abnormalities identified.
- a. Point Location/Description
  - a. EMS Readout (Setpoint and Actual)
  - b. Actual Readout
  - c. Interlocks
  - d. Safeties
    - 1) VSD Normal Operation
    - 2) VSD Bypass Operation
  - e. Alarms
  - f. Sequences of Operation

**END OF SECTION 23 05 93**

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**23 31 13**

**METAL DUCTS**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. HVAC air distribution ductwork.
- B. Duct pressure testing.

**1.2 RELATED WORK**

- A. Section 09 90 00 - Painting: Weld priming, weather resistant, paint or coating.
- B. Section 23 05 39 - Sleeves, Flashings, Supports and Anchors.
- C. Section 23 05 93 - System Testing, Adjusting & Balancing.
- D. Section 23 07 13 - HVAC Insulation.
- E. Section 23 33 00 - Ductwork Accessories.

**1.3 REFERENCES**

- A. ASHRAE – Fundamentals Handbook, Latest Version; Duct Design.
- B. ASHRAE - HVAC Systems and Equipment Handbook, Latest Version; Duct Construction.
- C. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- E. ASTM A527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- F. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- G. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.
- H. SMACNA – HVAC Duct Construction Standards, Metal and Flexible.
- I. SMACNA - HVAC Air Duct Leakage Test Manual.
- J. UL 181 - Factory-Made Air Ducts and Connectors.
- K. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

- L. IMC – International Mechanical Code, 2015 edition with City of Stafford, Texas amendments.

**1.4 DEFINITIONS**

- A. WG - Water Gauge
- B. Static Pressure - Total air pressure less velocity air pressure. Static pressure type is defined as positive or negative pressures relative to standard atmospheric conditions unless denoted otherwise.
- C. Duct Size - Net inside clear dimensions after insulation. Where offsets or transitions are required, the duct shall maintain the equivalent area based on hydraulic diameter and rectangular duct size for equal flow, velocity and pressure drop as calculated by Huebscher Formula #30 and/or #31 in ASHRAE Duct Design Fundamentals Handbook and associated Friction Chart for round duct.
- D. Pressure Classification - SMACNA standard classification system for ductwork applications not exceeding listed static pressure and velocity services. SMACNA standard static pressure classes are defined as follows:

Pressure Class	Operating Pressure (WG)	Pressure Type	Max Velocity (fpm)	Seal Class (Note 1)
1/2	< 1/2"	Any	< 2,000	C
1	>1/2" to 1"	Any	< 2,500	C
2	>1" to 2"	Any	< 2,500	B (Note 2)
3	>2" to 3"	Any	< 4,000	B
4	>3" to 4"	Positive Only	< 4,000	A
6	>4" to 6"	Positive Only	As Indicated	A
10	>6" to 10"	Positive Only	As Indicated	A

1. Note 1: Seal Classes shown for indoor applications; all exterior applications require Seal Class A regardless of pressure classification.
2. Note 2: Seal Class B required exceeding SMACNA minimum requirement.

**1.5 SUBMITTALS**

- A. Refer to other applicable sections for additional coordination drawings, duct shop drawings and product data and conform to provisions of Division 1.
- B. Shop Drawings:
  1. Prepare and submit ductwork shop drawings prior to fabrication and installation of ductwork. Contract documents are schematic in nature and are not an acceptable substitute for ductwork shop drawings.
  2. Include floor plans drawn to scale not less than 1/4" over appropriate project backgrounds. Include duct elevations and sections where proposed duct configurations cannot be fully depicted in plan view.
  3. Include relevant details such as duct size dimensions, pressure classification, sheet metal gages, joining methodology, duct construction technology, fittings and duct accessories prior to start of work.

4. Include coordination with the work of other applicable trades including architectural partitions, piping, electrical, lighting, and ceiling systems.
5. Indicate bottom of duct elevation dimensions.
6. Include details for offsets and transitions as required to permit ductwork to fit in the installation space allocated. Verify actual project field conditions and measurements as required.
7. Owner assumes no responsibility for reimbursing additional costs for duct revisions and/or rework required as a result of failure to prepare fully developed and detailed shop drawings.

#### **1.6 DELIVERY, STORAGE, AND HANDLING**

- A. Deliver, store, and protect products under provisions of Division 1.
- B. Protect duct from exposure to weather. Do not store duct in uncovered areas.
- C. The Contractor shall ensure that all ductwork either stored on site or installed in the building is thoroughly sealed to protect against dirt and moisture until such time that the building is deemed by the Owner to be adequately clean to allow for start-up of the associated air handling equipment. Should ductwork not be sealed as specified, then the Contractor shall have such ductwork professionally cleaned to an as-new condition at no cost to the Owner.
- D. Prevent entry into and/or habitation of ductwork by animals during storage and construction.
- E. Restore ductwork to like-new condition or replace contaminated by lack of adequate protection at no additional cost to Owner.

#### **1.2 QUALITY ASSURANCE**

- A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:
  1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  3. AWS D9.1/D9.1M, "Sheet Metal Welding Code," for duct joint and seam welding.

#### **1.7 QUALITY CONTROL**

- A. Obtain manufacturer's inspection and acceptance of installation of duct at beginning of installation for factory prefabricated duct systems.
- B. Provide 100% visual inspection of duct joint sealing prior to installation of thermal insulation coverings.
- C. All material (to include, but not limited to, insulation, jackets, facings, coatings, mastics, adhesive, sealants, etc.) Installed inside the building must have a certified and tested composite flame spread/smoke developed rating of 25/50 in accordance with ASTM E84.

#### **1.8 PRESSURE TESTING**

- A. Pressure test ducts rated for Pressure Class 3 inch or higher.
- B. Conduct tests using procedures consistent with SMACNA HVAC Air Duct Leakage Test Manual.
- C. Determine maximum acceptable rate of air leakage using duct leakage formula as follows:

$$F = C_L \times P^{0.65}$$

Where:

F = Maximum permissible airflow leakage in cfm/100 sq. ft. duct surface

P = Ducts static pressure in inch WG

C<sub>L</sub> = Leakage Class according to the table below

Duct Construction	Seal Class A	Seal Class B
Rectangular Construction	C <sub>L</sub> = 6	C <sub>L</sub> = 12
Round or Oval Construction	C <sub>L</sub> = 3	C <sub>L</sub> = 6

- D. Conduct duct leakage tests witnessed in writing by Owner's designated representative, independent TAB service, project commissioning authority, independent construction inspector, engineer of record, and/or authority having jurisdiction where required. Schedule testing with advance notification for test witness(s).
- E. Correct and retest ducts failing leakage tests at no additional cost to Owner.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Non-combustible and conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Non-Welded Steel Ducts: ASTM A525 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq. ft. for each side in conformance with ASTM A90.
- C. Welded Carbon Steel Ducts: ASTM 568 rolled carbon steel; SMAW, FCAW, or GMAW welded; minimum 18 gauge sheet metal thickness.
- D. Aluminum Ducts: Aluminum Alloy 3003, Temper H-14, minimum yield strength 21,000 lb/in<sup>2</sup>.
- E. Fasteners: Rivets, bolts, or sheet metal screws matching base duct materials.
- F. Sealant: Non-hardening, water resistant, fire resistive, suitable for applications and compatible with mating materials
  - 1. High solids mastics - high density type with excellent adhesions and elasticity suitable for sealing fillets, groves, and flanges.
  - 2. Liquid sealants - formulated specifically for duct applications containing not more than 60% volatiles suitable for filling voids 1/16 inch or less. Provide taped joint reinforcement for liquid sealants except machine fabricated longitudinal seams and slip-type joints.
  - 3. Reinforcing tapes - suitable for use with liquid sealed joints only. Pressure sensitive adhesive tape sealing systems are not acceptable without liquid mastic overcoat.
  - 4. Gaskets: soft elastomeric butyl rubber with adhesive backing suitable for use with flanged joints.
  - 5. Liquid sealants containing not more than 50% volatiles. May be used for slip type joint assembly to fill voids up to 1/16 inch clearance.

- G. Hangers:
1. Strap: Steel, galvanized.
  2. Rod: Steel, galvanized; continuously threaded.

## 2.2 CONSTRUCTION

- A. Galvanized Steel Rectangular Duct:
1. Single or double wall construction as indicated by application.
  2. Minimum 26 gauge sheet metal thickness.
  3. Longitudinal seams complying with the following industry standards:
    - a. Inside Groove Seam.
    - b. Sliding Seam.
    - c. Pittsburgh Lock.
    - d. Button-Punch Snap Lock.
  4. Transverse joints complying with the following industry standards:
    - a. Drive Slip.
    - b. S Slip.
    - c. Reinforced Bar-S Slip.
    - d. Pocket Joint.
    - e. Flanged Systems (Ductmate®, MEZ, or equal) comprised of:
      - 1) Rolled flanges with integral mastic seals.
      - 2) Bolted preformed corner pieces.
      - 3) Sealing gaskets.
      - 4) Flange joint drive cleats.
  5. Sealing Requirements
    - a. Class A – All transverse joints, longitudinal seams, and duct wall penetrations.
    - b. Class B – All transverse joints and longitudinal seams.
    - c. Class C – All transverse joints, except that all duct joints and longitudinal seams for all SMACNA classes of duct shall be sealed with U.L. listed Carlisle Hardcast DT-Tape and RTA-50 sealant.
- B. Galvanized Steel Round or Oval Duct
1. Single or double wall construction as indicated by application.
  2. Minimum 26 gauge sheet metal thickness
  3. Longitudinal seams complying with the following industry standards:
    - a. Continuous interlocking spiral wound.
    - b. Continuously seam welded.
    - c. Butt seam welded.
    - d. Gore locked seam.
  4. Transverse joints complying with the following industry standards:
    - a. Pipe & fitting coupled slip joint with radial fasteners.
    - b. Swedge sleeve.
    - c. Welded flanged & gasketed.
- C. Aluminum Duct
1. Comply with Galvanized Steel Rectangular, Round, or Oval Duct requirements except for sheet metal thickness.
  2. Provide equivalent steel sheet metal thickness per SMACNA HVAC Duct Construction Standards, Metal and Flexible Section 1.12. Minimum 0.032 inch sheet metal thickness. Minimum 0.014" thick aluminum, snaplock construction for residential clothes dryer exhaust.
- D. Flexible Round Duct
1. Flexmaster Type 5M insulated or equal.

2. Compliant with NFPA 90A & 90B
  3. U.L. 181 Class 1 listed
  4. ASTM E96 Procedure A rated for 0.05 Perm
  5. Interlocking spiral wire of galvanized steel or aluminum construction
  6. Aluminum foil, fiberglass, & aluminized polyester trilaminate liner
  7. Rated to 6 inches WG positive and 1 inches WG negative
  8. Insulated with 1" thick fiberglass insulation meeting R4.2
  9. Reinforced metalized outer vapor barrier
- E. Double Wall Thermal Duct (Interior Applications)
1. Shop fabricated or factory prefabricated double wall duct systems consisting of continuous inner and outer wall metal duct sections with integral thermal insulation preinstalled in the annular space separating the inner and outer wall sections.
  2. Reference Section 23 07 13 "HVAC Insulation", or other applicable Division 23 Sections for specific insulation requirements by application.
  3. Paintable outer surface suitable for use in aesthetically exposed applications.
  4. Comply with requirements of Galvanized Steel Rectangular, Round, and Oval Duct as applicable.
  5. Provide double wall systems complete with all fittings, taps, and accessories.
- F. Double Wall Thermal Duct (Exterior Applications)
1. Acceptable Manufacturers: Thermaduct or other Engineer accepted manufacturer of an approved equal product.
  2. General:
    - a. The panel shall be manufactured of CFC-free closed cell rigid thermoset resin thermally bonded on both sides to a factory applied 0.001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, 1000 micron high impact resistant titanium infused vinyl shall be factory bonded to the outer surfaces to provide a zero permeability water tight barrier.
    - b. Ductwork shall be provided with vinyl cladding, bolted corner joints, rated for 6" W.C. of positive or negative pressure and comply with SMACNA Air Leakage Class 1 requirements. Joints and seams of vinyl cladding shall be heat or chemically welded together for a weather-tight seam per manufacturer's recommendations.
  3. Insulation: Closed cell phenolic foam with a closed cell content of >90%.
    - a. Minimum Density: 3.5 pcf with a minimum compressive strength of 28 psi.
    - b. Maximum Temperature: Continuous rating of 185 degrees F inside ducts or ambient temperature surrounding ducts.
    - c. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
    - d. Minimum R-value: 8.1
    - e. Permeability: 0.00 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
    - f. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
    - g. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
    - h. Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.
  4. Closure Materials:
    - a. UV stable 1000 micron high impact resistant titanium infused vinyl.
      - 1) Factory manufactured seamless corners for zero perms.
      - 2) Cohesive bonded over-lap at corner seam covers for zero perms.

- 3) Water resistant titanium infused welded vinyl seams.
  - 4) Mold and mildew resistant.
  - b. Polymeric Sealing System:
    - 1) Structural Membrane: Aluminum scrim with woven glass fiber with a laminated UV stable vinyl jacket.
    - 2) Minimum Seam Cover Width: 2-7/8".
    - 3) Sealant: Low VOC.
    - 4) Color: Standard White (other light reflective colors available).
    - 5) Water resistant.
    - 6) Mold and mildew resistant.
  - c. Duct Connectors.
    - 1) Factory manufactured cohesive bonded strips (low pressure only).
    - 2) Factory manufactured all aluminum grip flange.
      - a) Grip flange
      - b) F-flange
      - c) H-flange
      - d) U-flange
    - 3) Factory manufactured galvanized 4-bolt flange.
  - 5. Outdoor Cladding: Duct segments shall incorporate UV stable 1000 micron high impact resistant titanium infused vinyl which is introduced during the manufacturing process.
  - 6. Flange coverings
    - 1) Foam tape insulation with molded 1000 micron covers.
    - 2) Air gap (heating only application) with molded 1000 micron covers.
- G. Double Wall Acoustical Duct
- 1. Shop fabricated or factory prefabricated double wall duct systems consisting of perforated inner and continuous outer wall metal duct sections with integral thermal acoustic insulation preinstalled in the annular space separating the inner and outer wall sections.
  - 2. Provide inner duct with 3/32 inch diameter perforation holes staggered at 3/16 inch on center.
  - 3. Reference Section 23 07 13 "HVAC Insulation" or other applicable Division 23 Sections for specific insulation requirements by application.
  - 4. Paintable outer surface suitable for use in aesthetically exposed applications.
  - 5. Conform to the requirements of galvanized steel rectangular, round, and oval duct as applicable.
  - 6. Provide double wall systems complete with all fittings, taps, and accessories.

## **PART 3 - EXECUTION**

### **3.1 GENERAL INSTALLATION REQUIREMENTS**

- A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards, Metal and Flexible and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for pressures indicated.
- B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No reduction of equivalent duct area is permitted except by reviewed shop drawings.
- C. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- D. Construct duct fittings per SMACNA standard details.

1. Provide typical supply, return and exhaust duct as detailed by SMACNA Section II fittings and other construction.
  2. The interior surface of all duct shall be smooth. No sheet metal parts, tabs, angles, or anything else may project into the ducts for any reason, except as specified to be so. All seams and joints shall be external.
  3. Provide 90 degree elbows constructed in accordance with SMACNA Figure 2-2, style RE-1 radius elbow (center line radius = 1.5 times duct height or width), space permitting; or style RE-2 square throat with turning vanes (provide duct access panel up stream of turning vanes for cleaning purposes) where required.
  4. Where rectangular elbows are used, provide single thickness turning vanes in accordance with SMACNA Figure 2.3; single wall type with trailing edge for duct velocities up to 1500 fpm and double wall turning vanes above 1500 fpm duct velocity.
  5. Provide parallel flow branches constructed in accordance with SMACNA Figure 2-7.
  6. Provide expanded 45 degree entry type rectangular duct branch connections.
  7. Provide spin-in type round branch duct connections in accordance with SMACNA Figure 2-8.
  8. Provide offsets and transitions in accordance with SMACNA Figure 2-9.
  9. Provide round spin-in fittings with locking quadrant volume dampers for all round duct connections to rectangular ducts. Spin-in and flex duct shall be same size as air distribution device neck diameter. Secure flex duct to spin-in and air distribution device neck with stainless steel worm gear clamps and seal vapor barrier. Suspend flex duct from structure above; round and flexible duct installations shall be as detailed by SMACNA in section III round, oval and flexible duct. Flexible duct supports shall be constructed and installed in accordance with SMACNA figures 3-9 and 3-10.
  10. Duct access doors shall be constructed in accordance with figure 2-12 and shall have a frame type 3, position 3 hinge with a type 2 locking handle; single and multi-blade volume dampers shall be in accordance with figures 2-14 and 2-15 respectively and shall have operator extensions when provided on externally insulated ducts; air distribution device connections shall be in accordance with figure 2-16 and ceiling diffuser branch ducts shall be in accordance with figure 2-17.
  11. Rectangular duct connections at all air moving equipment shall be flexible neoprene fabric and installed in accordance with figure 2-19.
  12. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
  13. All duct shall be fabricated in a manner to prevent the seams or joints being cut for the installation of air distribution devices.
  14. Provide crimps in direction of air flow where crimp joints with bead are used for joining round duct sizes 6 inch smaller.
- E. Where required, provide ducts with "ESS"-drive joints or flat seams to allow crossing of duct or installation of other equipment or piping requiring tight clearances. Raise ducts where required to allow installation of other duct or equipment using 45 degree radius elbows (center line radius = 1.5 times duct height) to offset.
- F. Provide openings in duct where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal well and closure device to ensure against air leakage. Where openings are provided in insulated duct, install insulation material inside a metal ring.
- G. Connect fan coil units to low pressure OA intake ducts with short length of flexible duct. Hold in place with corrosion resistant clamp or strap.

- H. Connect air distribution devices to low pressure ducts with 6 feet maximum, 4 feet minimum, length of flexible duct. Hold in place with corrosion resistant strap or clamp.
- I. All rectangular duct located exposed on roof shall have top horizontal surface "crowned or sloped" to prevent water from ponding.

**3.2 DUCT APPLICATION SCHEDULE**

- A. Unless indicated otherwise, provide duct systems complying with the following application schedule:

AIR SYSTEM	CONSTRUCTION	MATERIAL	PRESSURE CLASS
Main Supply Above Ceiling or Concealed	Single Wall	Galvanized Steel	Per AHU ESP, 3" Class Minimum
Main Supply Exposed in Unoccupied Spaces	Single Wall	Galvanized Steel	Per AHU ESP, 3" Class Minimum
Main Supply Exposed in Occupied Spaces	Double Wall	Galvanized Steel	Per AHU ESP, 3" Class Minimum
Main Supply Exposed Exterior	Single Wall	Welded Carbon Steel	Per AHU ESP, 3" Class Minimum
Downstream Supply Above Ceiling or Concealed	Single Wall	Galvanized Steel	Per Terminal ESP
Downstream Supply Exposed in Occupied Spaces	Double Wall	Galvanized Steel	Per Terminal ESP
Draw-thru Transfer, Return, or Relief	Single Wall	Galvanized Steel	1" Class
Pressurized Transfer, Return, or Relief	Single Wall	Galvanized Steel	Per Fan ESP
Draw-thru O/A Intake Above Ceiling or Concealed	Single Wall	Galvanized Steel	1" Class
Draw-thru O/A Intake Exposed in Occupied Spaces	Double Wall	Galvanized Steel	1" Class
Pressurized O/A Intake Above Ceiling or Concealed	Single Wall	Galvanized Steel	Per Fan ESP, 2" Class Minimum
Pressurized O/A Intake Exposed in Occupied Spaces	Double Wall	Galvanized Steel	Per Fan ESP, 2" Class Minimum
General Exhaust	Single Wall	Galvanized Steel	Per Fan ESP, 1" Class Minimum
Moist Air Exhaust (Shower Areas)	Single Wall	Aluminum	Per Fan ESP, 1" Class Minimum

**3.3 DUCT HANGERS AND SUPPORTS**

- A. All duct shall be properly suspended or supported from the building structure.

- B. The spacing, size and installation of hangers shall be in accordance with the recommendations of SMACNA, latest edition.
- C. Hangers shall be galvanized steel straps or hot-dipped galvanized rod with threads pointed after installation. Hangers shall be attached to the bottom of the duct.
- D. Provide double nuts and lock washers on threaded rod supports
- E. All duct shall be mounted tight to underside of structure and shall be top level with bottom and side transitions only, except that allowance shall be made for duct to be externally insulated, which shall be mounted 3" below structural beams and joists or other obstruction to allow installation of the external duct insulation.
- F. All duct risers shall be supported by angles or channels secured to the sides of the ducts at each floor. Secure floor supports to duct using rods, angles or flat bar to the duct joint or reinforcing. Provide miscellaneous steel supports for duct risers as required at no additional cost to Owner.
- G. Where ducts pass through walls in exposed areas, provide framed openings constructed of welded metal angles. All angles shall be carried around all four sides of the duct or group of ducts.

### **3.4 ADJUSTING AND CLEANING**

- A. Clean duct system by vacuuming and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

### **3.5 TESTING**

- A. Pressure test ductwork per Quality Control requirements.

**END OF SECTION 23 31 13**

**23 33 00**

**DUCTWORK ACCESSORIES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
1. Backdraft and pressure relief dampers.
  2. Barometric relief dampers.
  3. Manual volume dampers.
  4. Control dampers.
  5. Fire dampers.
  6. Duct-mounted access doors.
  7. Flexible connectors.
  8. Flexible ducts.
  9. Duct accessory hardware.

**1.3 SUBMITTALS**

- A. Product Data: For each type of product indicated.
1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
    - a. Special fittings.
    - b. Manual volume damper installations.
    - c. Control damper installations.
    - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Duct security bars.
- C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- D. Source quality-control reports.
- E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

#### **1.4 QUALITY ASSURANCE**

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with AMCA 500-D testing for damper rating.
- C. Comply with the 2015 edition of the International Energy Conservation Code (IECC) with City of Stafford, Texas amendments.

#### **1.5 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### **PART 2 - PRODUCTS**

#### **2.1 MATERIALS**

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A653/A653M.
  - 1. Galvanized Coating Designation: G90 (Z275).
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed and exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B221 (ASTM B221M), Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

#### **2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Greenheck Fan Corporation.
  - 3. Nailor Industries Inc.
  - 4. Pottorff; a division of PCI Industries, Inc.
  - 5. Ruskin Company.
  - 6. American Warming and Ventilating.

- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: 0.063-inch- thick extruded aluminum with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, maximum 6-inch width, 0.025-inch- thick, roll-formed aluminum noncombustible with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
  - 1. Material: Stainless steel.
  - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Synthetic pivot bushings.
- M. Accessories:
  - 1. Adjustment device to permit setting for varying differential static pressure.
  - 2. Counterweights and spring-assist kits for vertical airflow installations.
  - 3. Electric actuators.
  - 4. Chain pulls.
  - 5. Screen Mounting: Front mounted in sleeve.
    - a. Sleeve Thickness: 20-gage minimum.
    - b. Sleeve Length: 6 inches minimum.
  - 6. Screen Material: Aluminum.
  - 7. Screen Type: Bird.
  - 8. 90-degree stops.

### **2.3 BAROMETRIC RELIEF DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. American Warming and Ventilating; a division of Mestek, Inc.
  - 3. Greenheck Fan Corporation.
  - 4. Lloyd Industries, Inc.
  - 5. Nailor Industries Inc.
  - 6. Pottorff; a division of PCI Industries, Inc.
  - 7. Ruskin Company.
  - 8. American Warming and Ventilating.
- B. Suitable for horizontal or vertical mounting.
- C. Maximum Air Velocity: 2000 fpm.

- D. Maximum System Pressure: 2-inch WG.
- E. Frame: 0.063-inch thick extruded aluminum, with welded corners and mounting flange.
- F. Blades:
  - 1. Multiple, 0.025-inch-thick, roll-formed aluminum.
  - 2. Maximum Width: 6 inches.
  - 3. Action: Parallel.
  - 4. Balance: Gravity.
  - 5. Eccentrically pivoted.
- G. Blade Seals: Neoprene.
- H. Blade Axles: Nonferrous metal.
- I. Tie Bars and Brackets:
  - 1. Material: Aluminum
  - 2. Rattle free with 90-degree stop.
- J. Return Spring: Adjustable tension.
- K. Bearings: Synthetic.
- L. Accessories:
  - 1. Flange on intake.
  - 2. Adjustment device to permit setting for varying differential static pressures.

## 2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. McGill AirFlow LLC.
    - d. METALAIR, Inc.
    - e. Nailor Industries Inc.
    - f. Pottorff; a division of PCI Industries, Inc.
    - g. Ruskin Company.
    - h. Trox USA Inc.
    - i. American Warming and Ventilating.
  - 2. Standard leakage rating, with linkage outside air stream.
  - 3. Suitable for horizontal or vertical applications.
  - 4. Frames:
    - a. Hat-shaped, galvanized channels, 0.064-inch minimum thickness.
    - b. Mitered and welded corners.
    - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
  - 5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized, 0.064 inch thick.
  - 6. Blade Axles: Nonferrous metal.
  - 7. Bearings:

- a. Oil-impregnated bronze.
  - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

## 2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, [provide products by one of the following:
1. American Warming and Ventilating.
  2. Greenheck Fan Corporation.
  3. METALAIRE, Inc.
  4. Nailor Industries Inc.
  5. Pottorff; a division of PCI Industries, Inc.
  6. Prefco; Perfect Air Control, Inc.
  7. Ruskin Company.
- B. Type: Static; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Curtain type with blades outside air stream fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.
- F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
1. Minimum Thickness: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.
- G. Mounting Orientation: Vertical or horizontal as indicated.
- H. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.
- I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.
- J. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- K. Furnish and install where shown on the drawings or required by the Specifications, fire dampers meeting the following requirements.
- L. 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.

- M. 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.
- N. 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 air flow rates. Maximum pressure drop through fire damper shall not exceed 0.05 inch water gauge.
- O. 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 spacings 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.
- P. The damper installation shall be in accordance with the damper manufacturer's instructions.
- Q. All fire dampers shall comply with the Specification as written above and shall be Ruskin Model IBD2 (Style C, CR or CO), Greenheck Model FD-150 (Type C, CR or CO), or Pottorff.
- R. 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.
- S. 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.

## 2.6 COMBINATION FIRE/SMOKE DAMPERS

- A. Furnish and install where shown on the Drawings, or as required by the Specifications, combination fire/smoke dampers meeting the following requirements.
- B. 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 UL 555S, and bear a UL label attesting to same. 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 UL 555S 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.)
- C. 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.

- D. In addition to the leakage ratings specified herein, the combination fire/smoke dampers and their operators shall be qualified under UL 555S 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 which meets all applicable UL 555 and UL 555S 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.
- E. 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.
- F. 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 (2) 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.
- G. 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.
- H. 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.
- I. 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.
- J. All combination fire/smoke dampers shall comply with the specification as written above and shall be Ruskin Model FSD-60, Greenheck Model FSD-33, or Pottorff.
- K. 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.

- L. Dampers shall be UL labeled for use in dynamic systems. Closure reading shall be 110% of the maximum design air flow at the point of installation. The minimum closure pressure rating shall be 8" wg for air flow in either direction.

## 2.7 CEILING RADIATION DAMPERS

- A. Galvanized steel multiple blade type with UL 555C testing and rating. Damper shall be same size as return or supply air opening. No part of damper shall be in the air stream.
- B. Provide dampers as required to protect HVAC penetrations in the ceiling membrane portion of a fire rated floor/ceiling or roof/ceiling assembly.
- C. Dampers shall have 165 degrees F reusable thermal link.

## 2.8 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Flexmaster U.S.A., Inc.
  - 3. Greenheck Fan Corporation.
  - 4. McGill AirFlow LLC.
  - 5. Nailor Industries Inc.
  - 6. Pottorff; a division of PCI Industries, Inc.
  - 7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
  - 1. Door:
    - a. Double wall, rectangular.
    - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors Less Than 12 Inches Square: No hinges and two (2) sash locks.
    - b. Access Doors up to 18 Inches Square: Two (2) hinges and two (2) sash locks.
    - c. Access Doors up to 24 by 48 Inches: Three (3) hinges and two (2) compression latches.
    - d. Access Doors Larger Than 24 by 48 Inches: Four (4) hinges and two (2) compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
  - 1. Door and Frame Material: Galvanized sheet steel.
  - 2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
  - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  - 4. Factory set at 10-inch W.G.
  - 5. Doors close when pressures are within set-point range.
  - 6. Hinge: Continuous piano.

7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch thick, fibrous-glass or polystyrene-foam board.

## **2.9 FLEXIBLE DUCTS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Flexmaster U.S.A., Inc.
  2. McGill AirFlow LLC.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  1. Pressure Rating: 10-inch w.g. positive and 1.0-inch w.g. negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 10 to plus 160 deg F.
  4. Insulation R-value: Comply with IECC-2012.
- C. Insulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  1. Pressure Rating: 10-inch w.g. positive and 1.0-inch w.g. negative.
  2. Maximum Air Velocity: 4000 fpm.
  3. Temperature Range: Minus 20 to plus 210 degrees F.
  4. Insulation R-value: Comply with IECC-2012.
- D. Flexible Duct Connectors:
  1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches to suit duct size.
  2. Non-Clamp Connectors: Adhesive plus sheet metal screws.

## **2.10 DUCT ACCESSORY HARDWARE**

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## **2.11 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 so as 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 to be provided with 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**

#### **3.1 INSTALLATION**

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

#### **3.2 DAMPERS**

- A. Furnish and install 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. Volume dampers shall be equal to those of American Foundry. 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 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.
- H. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
  - 1. Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- I. Set dampers to fully open position before testing, adjusting, and balancing.
- J. Install test holes at fan inlets and outlets and elsewhere as indicated.
- K. Install fire dampers and ceiling radiation dampers according to UL listing.
- L. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Upstream from duct filters.
  - 3. At outdoor-air intakes and mixed-air plenums.
  - 4. At drain pans and seals.
  - 5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
  - 6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 7. At each change in direction and at maximum 50-foot spacing.
  - 8. Upstream and downstream from turning vanes.
  - 9. Upstream or downstream from duct silencers.
  - 10. Control devices requiring inspection.
  - 11. Elsewhere as indicated.
- M. Install access doors with swing against duct static pressure.

### **3.3 FIELD QUALITY CONTROL**

- A. Tests and Inspections:
  - 1. Operate dampers to verify full range of movement.
  - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
  - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation.
  - 5. Operate remote damper operators to verify full range of movement of operator and damper.

**END OF SECTION 23 33 00**

**23 37 00**

**AIR OUTLETS AND INLETS**

**PART 1 - GENERAL**

**1.1 WORK INCLUDED**

- A. Diffusers.
- B. Diffuser boots.
- C. Registers/grilles.
- D. Door grilles.
- E. Louvers.
- F. Louvered penthouse gravity ventilators.

**1.2 RELATED WORK**

- A. Division 08 – Openings: Door Louvers.
- B. Division 09 – Painting: Painting of Ductwork Visible Behind Outlets and Inlets.
- C. Division 10 – Specialties: Metal Wall Louvers.
- D. Section 23 00 00 – Basic Mechanical Requirements.
- E. Section 23 31 00 – Ductwork.
- F. Section 23 33 00 – Ductwork Accessories.

**1.3 REFERENCES**

- A. ADC 1062 - Certification, Rating and Test Manual.
- B. AMCA 500 - Test Method for Louvers, Dampers and Shutters.
- C. ANSI/NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
- D. AHRI 650 - Air Outlets and Inlets.
- E. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
- F. SMACNA - Low Pressure Duct Construction Standard.

**1.4 QUALITY ASSURANCE**

- A. Test and rate performance of air outlets and inlets in accordance with ADC Equipment Test Code 1062 and ASHRAE 70.

- B. Test and rate performance of louvers in accordance with AMCA 500.

## **1.5 REGULATORY REQUIREMENTS**

- A. Conform to ANSI/NFPA 90A.

## **1.6 SUBMITTALS**

- A. Submit product data under provisions of Division 01.
- B. Provide product data for items required for this project.
- C. Submit schedule of outlets and inlets indicating type, size, location, application, and noise level.
- D. Review requirements of outlets and inlets as to size, finish, and type of mounting prior to submitting product data and schedules of outlets and inlets.
- E. Submit manufacturer's installation instructions under provisions of Division 01.

## **PART 2 - PRODUCTS**

### **2.1 AIR SUPPLIES AND RETURNS**

- A. Grilles, registers and ceiling outlets shall be as scheduled on the Drawings and shall be provided with sponge rubber or soft felt gaskets. If a manufacturer other than the one scheduled is used, the sizes shown on the Drawings shall be checked for performance, noise level, face velocity, throw, pressure drop, etc., before the submittal is made. Selections shall meet the manufacturer's own published data for the above performance criteria. The throw shall be such that the velocity at the end of the throw in the five foot occupancy zone will be not more than 50 FPM nor less than 25 FPM. Noise levels shall not exceed those published in the ASHRAE Guide for the type of space being served (NC level). Grilles, registers and ceiling outlets shall be Titus, Krueger or Metalaire.
- B. Locations of outlets on Drawings are approximate and shall be coordinated with other trades to make symmetrical patterns and shall be governed by the established pattern of the lighting fixtures or architectural reflected ceiling plan. Where called for on the schedules, the grilles, registers and ceiling outlets shall be provided with deflecting devices and manual damper. These shall be the standard product of the manufacturer, subject to review by the Architect, and equal to brand scheduled.

### **2.2 ACCEPTABLE MANUFACTURERS - CEILING DIFFUSERS**

- A. Titus.
- A. Krueger.
- B. Metalaire.
- C. Price.
- D. Substitutions: Under provisions of Division 01.

### **2.3 RECTANGULAR CEILING DIFFUSERS**

- A. Rectangular, stamped, multicore type all aluminum diffuser to discharge air in 360 degree pattern with sectorizing baffles where indicated; Model OMNI-AA manufactured by Titus.
- A. Provide mounting frame to accommodate installation in ceiling types shown on the Drawings.
- B. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- C. The face panel shall be removable by means of four (4) hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners. The face panel shall project 1/4 inch below the outside border of the diffuser backpan. Panels projecting more than 1/4 inch below the outside border are not acceptable.
- D. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. A single metal thickness on the edges of the face panel will not be accepted. Ceiling diffusers with a 24 x 24-inch full face shall have no less than an 18 x 18-inch face panel size. Ceiling diffusers with a 12 x 12-inch full face shall have no less than a 9 x 9-inch face panel size.
- E. The backpan shall be one (1) piece precision die-stamped and shall include an integrally drawn inlet (welded-in inlets and corner joints are not acceptable). The diffuser backpan shall be constructed of 22-gauge aluminum. The diffuser neck shall have a minimum of 1¼-inch depth available for duct connection.
- F. Provide round volume damper and multi-louvered equalizing grid with damper adjustable from diffuser face. Optional round damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser.
- G. Provide directional blow clips as required to restrict the discharge air in certain directions where shown on the Drawings.
- H. Provide R-6, foil-backed molded insulation blanket with 1-inch gap around the neck to install insulated flex duct.

### **2.4 HIGH CAPACITY SQUARE, RECTANGULAR OR ROUND NECK CEILING DIFFUSERS**

- A. Ceiling diffusers shall be TITUS Model TDC (aluminum) for fixed, horizontal discharge pattern. These diffusers shall consist of an outer frame assembly of the sizes and mounting types shown on the plans and outlet schedule. A square or rectangular inlet shall be an integral part of the frame assembly and a transition piece shall be available to facilitate attachment of round duct. An inner core assembly consisting of fixed deflection louvers shall be available in one-, two-, three- or four-way horizontal discharge patterns. The inner core assembly must be removable in the field without tools for easy installation, cleaning or damper adjustment.
- B. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H.
- C. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering, or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

- D. Damper shall be constructed of heavy gauge aluminum. Damper must be operable from the face of the diffuser by removing the spring loaded inner core assembly. Throw Reducing Vanes (TRV) must be available to deflect a horizontal discharge airstream from each side of the TDC diffuser into diverging airstreams.
- E. The manufacturer shall provide published performance data for the diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70--2006 (RA 2011).

## **2.5 ACCEPTABLE MANUFACTURERS - CEILING REGISTERS/GRILLES**

- A. Titus.
- B. Krueger.
- C. Metalaire.
- D. Price.
- E. Substitutions: Under provisions of Division 01.

## **2.6 CEILING GRID CORE RETURN REGISTERS/GRILLES**

- A. Fixed grilles of 1/2 x 1/2 x 1/2 inch aluminum grid; Model 45F manufactured by Titus.
- B. Grilles must prevent line of sight when viewed directly from the face and provide a free area perpendicular to the 45 degree openings of at least 90%.
- C. Outer borders shall be constructed of heavy extruded aluminum with a thickness of 0.040-0.050 inch and shall have countersunk screw holes. Border width shall be 1¼ inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame.
- D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.

## **2.7 CEILING GRID CORE EXHAUST REGISTERS/GRILLES**

- A. Fixed grilles of 1/2 x 1/2 x 1/2 inch aluminum grid; Model 50F manufactured by Titus.
- B. Grilles must provide a free area of at least 90%.
- C. Outer borders shall be constructed of heavy extruded aluminum with a thickness of 0.040-0.050 inch and shall have countersunk screw holes. Border width shall be 1¼ inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame.
- D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- E. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers constructed of heavy gauge aluminum with removable key operator, operable from face.

**2.8 ACCEPTABLE MANUFACTURERS - WALL REGISTERS/GRILLES**

- A. Titus.
- B. Krueger.
- C. Metalaire.
- D. Price.
- E. Substitutions: Under provisions of Division 01.

**2.9 WALL SUPPLY REGISTERS/GRILLES**

- A. Streamlined and individually adjustable blades, 3/4 inch spacing with spring or other device to set blades, horizontal face, double deflection; Model 272FL manufactured by Titus.
- B. Fabricate 1 inch margin frame with concealed mounting and gasket.
- C. Fabricate of aluminum with 20 gauge minimum frames and 22 gauge minimum blades, aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish.
- D. Front blades shall be parallel to the long dimension. Blades shall be constructed of heavy duty aluminum and shall be contoured to a specifically designed airfoil cross-section to meet published performance data. Hollow blades are not acceptable. Blades must be solid. Blades shall be spaced 3/4-inch apart. Blades shall extend completely through the side frame on each side to ensure stability throughout the complete cfm operating range of the grille. Blades shall be individually adjustable without loosening or rattling and shall be securely held in place with tension wire.
- E. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- F. Provide integral, gang-operated opposed blade dampers constructed of heavy gauge aluminum with removable key operator, operable from face.

**2.10 WALL EXHAUST AND RETURN REGISTERS/GRILLES**

- A. Streamlined blades, depth of which exceeds 3/4 inch spacing parallel to the long dimension, with spring or other device to set blades, as scheduled; Model 350F manufactured by Titus.
- B. Fabricate 1-1/4 inch margin frame with concealed mounting. Minimum border thickness shall be 0.040-0.050 inch.
- C. Fabricate of aluminum with 20 gauge minimum frames and 22 gauge minimum blades, aluminum with 20 gauge minimum frame, or aluminum extrusions, with factory baked enamel finish.
- B. Corners shall be welded with full penetration resistance welds. Sizes larger than 24 x 24 inches shall be constructed by using heavy aluminum extrusions and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be counter-sunk for a neat appearance.

- C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be set at 35°.
- D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250-hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50-inch pound force applied.
- E. Where not individually connected to exhaust fans, provide integral, gang-operated opposed blade dampers constructed of heavy gauge aluminum with removable key operator, operable from face.
- F. In gymnasiums, blades shall be front pivoted, welded in place, or securely fastened to be immobile.

#### **2.11 ACCEPTABLE MANUFACTURERS - LOUVERS**

- A. American Warming and Ventilating.
- B. Greenheck.
- C. Arrow United Industries.
- D. Ruskin.
- E. Substitutions: Under provisions of Division 01.

#### **2.12 LOUVERS**

- A. Acceptable Product: Model EME6325D as manufactured by Ruskin Company or Engineer accepted equivalent.
- B. Listings:
  - 1. AMCA 540 Level E and AMCA 550 Listing with the Air Movement and Control Association Certified Ratings Program.
  - 2. Miami-Dade Acceptance Number: 15-0731.07.
  - 3. Florida Notice of Acceptance Number: FL 14156.1.
- C. Fabrication:
  - 1. Design: Extruded aluminum, stationary louvers with horizontally mounted drainable blades.
  - 2. Application: Miami-Dade Approved Product for use in open structures or installations where the enclosed space is designed to accommodate water infiltration (wet rooms). Miami-Dade County Protocols Compliance:
    - a. TAS-202 Uniform Static Air Pressure Test.
    - b. TAS-203 Cyclic Wind Pressure Test – Maximum Design Pressure Rating +/- 120 psf.
  - 3. Frame:
    - a. Frame Depth: 6 inches, nominal.
    - b. Wall Thickness: 0.095 inch, nominal.
    - c. Material: Extruded aluminum, Alloy 6063-T6.
  - 4. Blades:
    - a. Style: Vertically mounted.
    - b. Wall Thickness: 0.062 inch, nominal.

- c. Material: Extruded aluminum, Alloy 6063-T6.
- 5. Sill: Sill Flashing: Formed aluminum, 0.080 inch, upturned sides to prevent water leakage.
  
- D. Performance Data:
  - 1. Performance Ratings: AMCA licensed.
    - a. Based on testing 48 inches x 48 inches size unit in accordance with AMCA 500-L.
  - 2. Free Area: 42 percent, nominal.
  - 3. Free Area Size: 6.66 square feet.
  - 4. Maximum Recommended Air Flow through Free Area: 2,155 feet per minute.
  - 5. Air Flow: 10,431 cubic feet per minute.
  - 6. Maximum Pressure Drop (Intake): 0.60 inches w.g.
  - 7. Water Penetration: Beginning point of water penetration of 0.01 ounce per ft<sup>2</sup> of free area shall be above 1,250 feet per minute free area velocity.
  - 8. Wind Load Rating: Maximum wind load of ±150 PSF.
  - 9. AMCA 500-L Wind Driven Rain Performance: 99.9 percent effective at preventing water penetration through louver when tested at 50 miles per hour wind with 8 inches per hour rainfall and 2,155 feet per minute airflow through the free area. Penetration Class 'A' with Discharge Class (Intake) '3' in accordance with AMCA 500-L Wind Driven Rain Test.
  
- E. Design Wind Criteria
  - 1. Ultimate Wind Speed: 147 mph, 3-second gust
  - 2. Exposure: B
  - 3. Risk Category: III.

## **2.13 LOUVERED PENTHOUSE GRAVITY VENTILATOR**

- A. Extruded Aluminum Tiered Louver Ventilator: Welded, all aluminum construction meeting the following minimum construction requirements:
  - 1. Frame: Heavy gauge extruded 6063-T5 aluminum, 6 in. x 0.081 in. nominal wall thickness
  - 2. Blades: Horizontal rain resistant design, heavy gauge extruded 6063-T5 aluminum, 0.081 in. nominal wall thickness, positioned on approximately 2 in. centers
  - 3. Construction: Welded and mechanically fastened.
  - 4. Birdscreen: 3/4 in. x 0.051 fattened expanded aluminum removable frame, inside mount (rear).
  - 5. Finish: Mill.
  
- B. Assembly shall be tested in accordance with and pass TAS 202 (Uniform Static Air Pressure) and TAS 203 (Cyclic Wind-Loading).
  
- C. Mount on minimum 8" high factory fabricated galvanized steel curb with 1/4" x 2" sponge rubber pad at mounting surface and 2" thick fiberglass insulation board.
  
- D. Acceptable Product: Greenheck Model EHH-601PD or Engineer accepted equivalent.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Install items in accordance with manufacturers' instructions.
  
- B. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement. Refer to Division 09.
  
- C. Install diffusers to ductwork with airtight connection.

- D. Provide balancing dampers on duct take-off to diffusers, and grilles and registers, regardless of whether dampers are specified as part of the diffuser, or grille and register assembly.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Division 09.
- F. All louvers located above ceilings are to have sheet metal plenums. Plenums are to be welded or soldered and shall be watertight. Plenum bottoms also shall slope to louver and the connection to the louver shall be watertight.
- G. Secure all roof mounted equipment to the structure adequately to resist overturning, uplift and sliding forces for the following wind design criteria:
  - 1. Ultimate Wind Speed: 147 mph, 3-second gust.
  - 2. Exposure: B.
  - 3. Risk Category: III.

**END OF SECTION 23 37 00**

**26 05 00**

**COMMON WORK RESULTS FOR ELECTRICAL**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Follow and comply with the SMSD MEP Electrical Standards.
- C. Coordinate with Commissioning Requirements indicated in Section 019113. This Contractor is responsible to comply with all requirements for the above section.

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Summary of Work.
  - 2. Submittals, Analysis and Device Schedules.
  - 3. Record Documents.
  - 4. Operating and Maintenance Manuals.
  - 5. General Electrical Product Requirements.
  - 6. General Electrical Installation Requirements.
  - 7. Electrical equipment coordination and installation.
  - 8. Sleeves for raceways and cables.
  - 9. Sleeve seals.
  - 10. Grout.
  - 11. Common electrical installation requirements.
- B. Provide all work required for complete electrical and ancillary system as indicated on the drawings and in these specifications. This may include, but is not necessarily limited to; panelboards, transformers, cabinets, motor controllers, circuit breakers, fuses, disconnect switches, surge suppression, fire alarm system, Lighting Control System, interior and exterior lighting, parking lot lighting, lamps, relay panels, contactors, controls, wiring devices, wire and cable, grounding and bonding, lightning protection, equipment wiring system, conduit, raceways, boxes, supporting devices, identification, fire stopping, testing, excavating, concrete equipment bases, concrete duct encasements, conduit sleeves and supports, anchors, vibration and sound isolation, access panels, record drawings, installation permits, inspections by governing authorities, electrical work of certain temporary facilities and services, cutting-and-patching work, utility connection coordination, start-up of electrical systems and equipment, training of Owner's operating personnel, operating and maintenance manuals, final cleaning of electrical and similar work.
- C. Except where otherwise indicated, electrical drawings prepared by Engineer (contract drawings) are diagrammatic in nature and may not show locations accurately for various components of electrical systems. It is the intention of the Construction Documents to establish the types and functions of the systems, but not to set forth each and every item essential to the functioning of any system. The Contractor shall make necessary changes or additions as may be reasonably inferred from the construction documents for a complete operating system as required and record these on the record documents at no cost to the Owner.

- D. Contractor shall visit site prior to submitting his proposal and become familiar with the conditions under which the Work is to be performed, and correlate site observations with the requirements of the Contract Documents. Errors, inconsistencies or omissions discovered shall be reported to the Architect/Engineer at once.
- E. All electrical products and installations shall comply with the latest additions of the following standards where applicable:
1. ADA - AMERICANS WITH DISABILITIES ACT
  2. ANSI - AMERICAN NATIONAL STANDARDS INSTITUTE
  3. ASTM - AMERICAN SOCIETY FOR TESTING AND MATERIALS
  4. CBM - CERTIFIED BALLAST MANUFACTURERS
  5. ETL - ELECTRICAL TESTING LABORATORIES
  6. FM - FACTORY MUTUAL
  7. ICEA - INSULATED CABLE ENGINEERS ASSOCIATION
  8. IEEE - INSTITUTE OF ELECTRONICS AND ELECTRICAL ENGINEERS
  9. NEC - NATIONAL ELECTRICAL CODE
  10. NECA - NATIONAL ELECTRICAL CONTRACTORS ASSOCIATION
  11. NEMA - NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
  12. NESC - NATIONAL ELECTRICAL SAFETY CODES
  13. NFPA - NATIONAL FIRE PROTECTION ASSOCIATION
  14. NETA - INTERNATIONAL ELECTRICAL TESTING ASSOCIATION
  15. OSHA - OCCUPATIONAL SAFETY AND HEALTH ASSOCIATION
  16. UBC - UNIFORM BUILDING CODE
  17. IBC – INTERNATIONAL BUILDING CODE
  18. ICC – INTERNATIONAL CODE COUNCIL
  19. IECC – INTERNATIONAL ENERGY CONSERVATION CODE
  20. ISO – INTERNATIONAL ORGANIZATION FOR STANDARDIZATION
  21. UNDERWRITERS LABORATORIES, INC.
  22. TAS – TEXAS ACCESSIBILITY STANDARDS
  23. STATE ENERGY CONSERVATION CODE
  24. MUNICIPAL OR COUNTY CODES. In the event of conflicts between codes or standards, the more stringent requirements shall govern.
- F. All work and materials shall be warranted as indicated in Division 1.
- G. Contractor is responsible for filing and paying for all fees and obtaining necessary permits and certificates of inspection, and shall deliver all certificates of inspection to Owner, and include copies with maintenance manuals.

### **1.3 DEFINITIONS**

- A. NRTL: Nationally Recognized Testing Laboratory, including United Laboratories (UL) and Intertek (ETL).

### **1.4 SUBMITTALS**

- A. General Submittal Requirements:
1. All submittals shall be in accordance with Division 1 requirements.
  1. Submit number of copies indicated in Division 1 or 6 copies, whichever is greater.
  2. Applicability: Wherever it is indicated that shop drawings, samples, manufacturer's brochure, certification, test, copy of standard operating instructions, manual, extra stock, or warranty is required, appropriate submittal is required regardless of whether it is specified as "submittal"; Engineer's decision shall be final.
  3. Do not purchase equipment until submittals have been reviewed by Engineer with no exceptions taken.

4. Signed Commitments: Do not proceed with transfer of electrical systems to Owner for operation until warranties, performance certifications, maintenance agreements and similar commitments to be signed by Contractor and other entities have been executed and transmitted to Engineer (for Owner's records).
  5. Response to Submittals: Where standard product data have been submitted in fulfillment of project requirements, it is recognized that submitter has already determined that products fulfill specified requirements, and that submittals are for engineer's information only, but will be returned without action where observed to be non-complying with requirements. Where uniquely prepared information is submitted, it is recognized to represent preparer's interpretation or solution to specified requirements, subject to Engineer's concurrence and appropriate action as indicated in Division 1.
  6. Submittals shall be signed by the General Contractor and Subcontractor responsible for this work.
  7. The Engineer's review of submittals is solely for general conformance with the design concept. The Engineer's review does not relieve the Contractor from total responsibility for quantities, errors, omissions or compliance with the intent of the original contract documents. Review and approval by the Contractor is required before fabrication, shipment or installation.
- B. Substitutions: Electrical submittals are not opportunities for gaining acceptance of substitutions. Any variance from the contract documents shall be identified in accordance with Division 1 requirements. Substitutions will be reviewed only for those reason identified in Division 1 and only if the procedures identified in Division 1 are followed. Any variances from the contract documents in the submittals which are not identified by the Contractor in accordance with the procedures of Division 1 and subsequently not identified by the Engineer's review shall be corrected by the Contractor at no cost to the Owner. Substitution request would only be considered if product is equal or better than what listed. No substitution will be allowed for fire alarm system and any electrical products and equipment.
- C. Coordination Drawings: Prior to any submittals being reviewed, the Contractor shall provide the coordination drawings indicated in Division 1. In accordance with Division 1, the coordination drawings shall show work in and above ceilings and in mechanical and electrical rooms with horizontal and vertical dimensions to avoid interference with structural framing, ceilings, partitions and other services. The coordination drawings shall be to a scale of 1/4" = 1'-0" or larger. Coordination drawings in the buildings shall include but not be limited to all Electrical rooms with size and location, major electrical equipment and accessories, switchgear and clearances, HVAC ductworks in rooms, plumbing, air grilles, light fixtures, communications equipment, access panels, transformers, switchboards, panelboards, control panels, fire alarm equipment, code clearances for equipment, manufacturers required maintenance clearance for equipment, concrete equipment pads, exterior wall penetrations, foundation penetrations, and fire rated wall penetrations.
- D. Short Circuit Analysis: Prior to any electrical submittals being reviewed, the Contractor shall perform short-circuit analysis of the specified electrical power distribution system. This analysis shall include:
1. A calculation of the maximum RMS symmetrical three-phase short-circuit current available at each panel location in the electrical system. The results shall represent the highest short-circuit currents to which the equipment might be subjected under the reported system conditions. The short circuit currents shall be calculated with the aid of a computer. The Contractor shall obtain necessary information from the utility to do this prior to furnishing equipment and coordinate with manufacturer to meet the greater of minimum required rating and rating indicated on Drawings.
  1. Appropriate motor short-circuit contribution such that the calculated values will represent the highest short-circuit current to which the equipment will be subjected under fault conditions.

2. A tabular computer printout of equipment supplied by the electrical ratings of the electrical equipment supplied by the electrical manufacturer, the calculated short-circuits currents, X/R ratios, and notes regarding the adequacy or inadequacy of the equipment.
  3. A computer printout of input circuit data including cable lengths, number of cables per phase, cable impedance values, insulation types, transformer impedances, X/R ratios and other circuit information as related to the short-circuit calculations.
  4. A bus-to-bus computer printout listing the maximum available short-circuit current in RMS symmetrical amperes and the X/R ratio of the fault current. This printout shall have an accompanying printout explaining how to interpret the short-circuit results.
  5. A computer-generated system one-line diagram clearly identifying individual equipment buses, bus numbers used in short-circuit analysis, cable and bus connections between the equipment and calculated maximum short-circuit current at each bus location.
  6. A discussion section evaluating the adequacy or inadequacy of the equipment, with recommendations as required for improvements to the system.
  7. Any inadequacies shall be called to the attention of the engineer and recommendations made for improvements.
  8. Six (6) bound copies of the completed short-circuit analysis sealed by a Texas Licensed Professional Electrical Engineer shall be submitted for the Engineer to review.
- E. Protective Device Time-Current Coordination Analysis: Prior to any electrical equipment submittals being reviewed, the Contractor shall perform a protective device time-current coordination analysis of the specified electrical power distribution system. This analysis shall include:
1. A determination of settings, ratings, or types for the over-current protective devices supplied. Where necessary, an appropriate compromise shall be made between system protection and service continuity with:
    - a. System protection shall be more important than service continuity. The time current condition analysis shall be performed with the aid of a computer.
  2. Computer generated log-log plots containing the time current characteristics of over-current devices. A sufficient number of log-log plots shall be provided to indicate the degree of system protection and coordination. The log-log plots shall include transformer ANSI withstand point and inrush currents of transformers where appropriate. Series rated devices shall not be acceptable.
  3. Computer printouts to accompany the log-log plots containing descriptions for each of the devices shown on the plot, setting of the adjustable devices, device numbers to simplify locations of the devices on the system one-line diagram and short circuits where shown.
  4. A tabular computer printout of the suggested settings of the adjustable over-current protective devices, the equipment where the devices are located, the device number corresponding to the device on the system one-line diagram and the number of the time-current log-log graphs where they are illustrated.
  5. A computer generated system one-line diagram clearly identifying individual equipment buses, the bus numbers, the device numbers and the maximum available short-circuit at each bus which shall include short-circuit current motor contributions.
  6. A discussion section evaluating the degree of system protection and service continuity with over-current devices, with recommendations as required for increased protection or coordination.
  7. Any inadequacies shall be called to the attention of the engineer and recommendations made for improvements.
  8. Six bound copies of the completed protective device time-current coordination analysis for the engineer.
- F. Over-current Device Schedule: Prior to any electrical submittals being reviewed, Contractor shall provide a schedule for each piece of equipment required by Divisions 11, 14, 21, 22, 23, 25, 27, and 28 in coordination with subcontractors providing equipment under these sections. Submittals shall reflect required coordination by having related Contractor's signatures on the

submittals. This means that electrical requirement for chiller as an example, shall be coordinated by BOTH Electrical and Mechanical subcontractors, and Over-Current Device Schedule submitted shall be signed by both Contractors. For each piece of equipment actually supplied, the schedule shall indicate the full load amps (FLA), the minimum circuit amps (MCA), and the maximum over-current protection device (MOCPD). The schedule shall also indicate if the equipment is required to be protected by fuses only, thermal magnetic breaker only, HACR breakers only or any combination thereof. It shall also indicate if the equipment requires single point or multiple point of connections and how the Contractor is proposing to meet the requirements if different than construction documents. It shall explicitly indicate the required number of conductors, disconnect switch sizes and numbers (if required), and acceptable conduit sizes and number. These modifications shall be reflected in the electrical equipment submittal. Required changes shall be made at no cost to the Owner.

- G. After the coordination drawings, short circuit analysis coordination analysis and over-current device schedule are submitted, the products in Division 26 shall be submitted in the groups identified below. By submitting shop drawings on the project, this Contractor is indicating that all necessary coordination has been completed and that the systems, products and equipment submitted can be installed in the building and will operate as specified and intended, in full coordination with all other trades. Submittals for each group will be returned without review unless all sections are included. Sections will not be reviewed separately. At the Engineer's discretion, when a re-submittal is required for one section, any other sections within each group may require re-submittal. Contractor shall expedite submittals and re-submittals as required to allow for the Engineer's review time specified in Division 1. The groups of equipment shall be divided as follows:
1. Raceways, Conductors and Miscellaneous Equipment
    - a. Fire stopping
    - b. Conduit
    - c. Raceways, Multi-outlet Assemblies, Wireways and Auxiliary Gutters
    - d. Wires and Cables
    - e. Outlet Boxes
    - f. Wiring Devices
    - g. Cabinets and Enclosures
    - h. Grounding and Bonding
    - i. Supporting Devices
    - j. Electrical Identification
    - k. Lightning Protection Systems
  2. Distribution Equipment
    - a. Distribution Switchboards
    - b. Enclosed Switches
    - c. Dry Type Transformers
    - d. Distribution Panelboards
    - e. Branch Circuit Panelboards
    - f. Enclosed Motor Controllers
    - g. Motor Control Center
    - h. Variable Speed Drives
  3. Electrical Controls
  4. Emergency Backup System
    - a. Enclosed Automatic Transfer Switches
    - b. Natural Gas Generator Sets
  5. Lighting Fixtures
    - a. Interior and Building Lighting Fixtures
  6. Specialty Systems
    - a. Transient Voltage Surge Suppression
    - b. Fire Alarm System
    - c. Intercom System

- d. Cable TV System
- e. Local sound reinforcement System
- 7. Testing
  - a. Field Electrical Testing
- H. Shop Drawings: Prepare electrical shop drawings to accurate scale except where diagrammatic representations are specifically indicated. Show clearance dimensions of critical locations, and show dimensions of spaces required for operation and maintenance of equipment. Show conduit layouts and wire/cable connections and other electrical service connections and show interfaces with other work, including structural support. Indicate by note, portions of electrical work shown on shop drawings which deviates from indication of work in contract documents, and explain reasons for deviations. Show how such deviations coordinate with interfacing deviations on shop drawings for other portions of work, currently or previously submitted. Show wiring diagrams, erection, setting, weights, capacities, speeds, outputs, consumption, efficiencies, voltages, amperages, hertz, phases, noise levels, etc.
- I. Samples: Engineer's review of required sample submittals will be limited to observation of general type, pattern, and finish; and will not include testing and inspection of submitted samples, except for those specifically indicated for that purpose in the contract documents. Compliance with specified requirements remains the exclusive responsibility of the Contractor.
- J. Manufacturer's Data: Where pre-printed data covers more than one distinct product, size, type, material, trim, accessory group or other variation, mark submitted copy with black pen to indicate which variations are to be provided. Delete or mark-out all portions or pre-printed data which are not applicable. Where operating ranges are shown, mark data to show portions of range required for project application. Expansion or elaboration of standard data to describe non-standard product must be processed as shop drawing data to describe non-standard product. For each product include manufacturer's production specifications, installation or fabrication instructions, nearest source of supply (including telephone number), sizes, weights, speeds, operating characteristics, ratings, conduit and wire/cable connection sizes and locations, statements of compliance with required standard and governing regulations (include manufacturer's signed statements if not covered in printed data), performance data (where applicable) and similar information needed to confirm compliance with requirements.
- K. Manufacturer's Certification: Each manufacturer is required to review the system design as related to the proper operation of his equipment, including electrical requirements, automatic controls, mechanical systems and equipment locations and related items. With shop drawings submit a letter from the manufacturer stating that his equipment will operate satisfactorily under the design conditions. The manufacturer's representative shall review the final installation at the site and submit a second letter stating that the equipment operates satisfactorily as installed. Furnish certification for the systems listed in each section of Division 26.
  - 1. Test Reports: The Contractor for various sub-systems shall submit proposed testing procedure for their system, subject to review and approval and owner acceptance. The contract will not be declared to be substantially complete until the functional operation of the subsystems have been demonstrated and verified and reports have been provided, reviewed and accepted. The project will not be declared substantially complete until the following has taken place:
  - 2. The "As-Built" drawings have been submitted, reviewed, and accepted by SMSD CM-PA/Bond Office.
  - 3. The various systems have been commissioned and accepted. This will include the following systems:
    - a. Building Fire Alarm System
    - b. Clock System
    - c. Television Distribution System
    - d. Building Computer Network

- e. Surveillance and Security System
- f. Intercom/Telephone
  
- L. Submit test report signed and dated by firms performing test, and prepare in manner specified in standard or regulation governing test procedure as indicated. Provide notarized executions on test reports.
  
- M. Warranties: Refer to Division 1 for procedures and submittal requirements for warranties. Refer to individual equipment specifications for warranty requirements. A minimum of one-year warranty period is required for all materials and equipment. Warranty period starts upon first beneficial use or acceptance by SMSD whichever comes first.
  - 1. Provide complete warranty information for each item to include product or equipment to include date of beginning of warranty or bond; duration of warranty or bond; names, addresses and telephone numbers and procedures for filing a claim and obtaining warranty services.
  - 2. Where pre-printed and published warranty includes substantial deviation from required warranty (as judged by Engineer), product is automatically disqualified from use on project, except where manufacturer prepares and issues specific project, warranty on product, stating that it is in lieu of published warranty, and is executed by authorized officer, and complies with requirements.
  
- N. Load Current and Overload Relay Heater List: Compiled by Contractor after motors have been installed. Arrange to demonstrate selection of heaters to suit actual motor nameplate full load currents.

### 1.5 RECORD DOCUMENTS

- A. Prepare record documents in accordance with the requirements in Division 1. In addition to the requirements specified in Division 1, indicate installed conditions for:
  - 1. Major raceway systems, size and location, for both exterior and interior; locations of control devices; distribution and branch electrical circuitry; access panels; and fuse and circuit breaker size and arrangements.
  - 1. Equipment locations (exposed and concealed), dimensioned from prominent building lines.
  - 2. Approved substitutions, Contract Modifications, and actual equipment and materials installed.
  - 3. Underground cabling and conduits both interior and exterior, drawn to scale and fully dimensioned.
  - 4. Work concealed behind or within other work, in a non-accessible arrangement.
  - 5. Mains and branches of wiring/cabling systems, with switchboards, panelboards, and control equipment and devices located and numbered with terminals and connections located, and with equipment requiring maintenance located.
  - 6. Grounding systems including primary, secondary and special.
  
- B. Execution: Each installer or other entity responsible for recording installed work shall record firm name, signature and date on each drawing so marked.
  
- C. Prior to transmittal of corrected drawings, obtain three (3) sets of blue-line prints of each drawing in each set, regardless of whether corrections were necessary, and include in transmittal (two (2) sets are for Owner's use, and one (1) is for Engineer's records).

### 1.6 OPERATING AND MAINTENANCE MANUALS

- A. Prepare maintenance manuals in accordance with Division 1. In addition to the requirements specified in Division 1, provide the following.

- B. Submit sets prior to final inspection, in electronic PDF format.
- C. Contents:
  - 1. Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractor, and major equipment suppliers.
  - 1. Operation and maintenance instructions, arranged by system.
  - 2. Project documents and certificates.
  - 3. Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.
  - 4. Manufacturer's original printed operating procedures to include start-up, break-in, and routine and normal operating instructions; regulation, control, stopping, shutdown, and emergency instructions; and summer and winter operating instructions. (Copies are not acceptable).
  - 5. Maintenance procedures for routine preventative maintenance and troubleshoot; disassembly, repair, and re-assembly; aligning and adjusting instructions.
  - 6. Servicing instructions and lubrication charts and schedules.
  - 7. Warranty information including any corrections made during submittals.
  - 8. Replacement parts list.
  - 9. List of tools and accessories needed for maintenance.

## 1.7 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
  - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
  - 1. To provide for ease of disconnecting the equipment with minimum interference to other installations.
  - 2. To allow right of way for piping and conduit installed at required slope.
  - 3. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## PART 2 - PRODUCTS

### 2.1 GENERAL MANUFACTURER QUALIFICATION

- A. Production Experience: For all electrical equipment, manufacturer shall be firm with not less than five (5) years successful production experience. Experience means production of units similar to those required, as judged by Engineer. Comply with longer-period experience requirements specified in other Division 26 sections of these Specifications. Product shall be new and design for quiet, vibration free operation.

## 2.2 GENREAL ELECTRICAL PRODUCT REQUIREMENTS

- A. Standard Products: Provide not less (quality) than manufacturer's standard products as specified by published product data. Do not assume that available off-the-shelf condition of product complies with requirements; as example, specific finish or color may be required.
- B. Unencumbered Purchases: Avoid purchases and use of products which are encumbered with questionable title transfers, patent rights, trade union restrictions, code compliance, non-listings as "approved products" for compliance with governing regulations, duties due, embargoes and similar possible encumbrances, claims or seller's interest.
  - 1. Purchasing: Do not purchase specific electrical materials and equipment for project until completion of submittals.
- C. Condition of Products: Except as otherwise indicated, provide new electrical products, free of defects and harmful deterioration at time of installation. Do not use units, which have been subjected to destructive testing, or other high-limits testing except where pre-tested products are specified. Comply with Division 1 requirements for exposure or visual display limitations against trademarks and manufacturer's names. Provide each product complete with trim, accessories, finish, guards, safety devices and similar components specified or recognized as integral parts of products, or required by governing regulations.
- D. Assembly and Testing: To greatest extent possible and unless otherwise indicated, complete fabrication, assembly, finishing and testing of products prior to delivery to project. Notify Engineer not less than one week in advance of pre-installation testing to be performed in response to project requirements. Engineer reserves right to be present at tests of electrical products; however, neither their absence nor presence relieves the Contractor of responsibility for compliance with requirements.
- E. Uniformity: Where multiple units of generic product are required for single major system of electrical work, e.g., cable trays, lighting systems, provide identical products by same manufacturer, without variations.
  - 1. Limitations: Product/manufacturer uniformity does not apply to conduit and fittings, 600V electrical wire, sheet metal, steel bar stock, welding rods, solder, factory applied paint between different systems, fasteners, motors for unalike equipment units, and similar items used in work, and except as otherwise indicated.
- F. Product Compatibility, Options: Where more than one product selection is specified, selections are Purchaser's or Installer's options, except do not provide products which are not compatible with previously purchased or installed products which must interface with selections. Provide electrical adaptations as needed for interfacing of selected products in work.
- G. Quality Assurance: Provide products listed by and installed in accordance with all references in each section under quality assurance any other applicable requirements.
- H. Elevation Requirements: Electrical equipment provided shall perform at mean elevation of 1000 feet above sea level.
- I. Listing: Provide products that are listed by a NRTL.

## 2.3 SLEEVES FOR RACEWAYS AND CABLES

- A. Retain one of first two paragraphs below for penetrations through exterior walls above and below grade.

- B. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- C. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water-stop, unless otherwise indicated.
- D. Sleeves for Rectangular Openings: Galvanized sheet steel.
  - 1. Minimum Metal Thickness:
    - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
    - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

## 2.4 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

## 2.5 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, non-staining, mixed with water to consistency suitable for application and a 30-minute working time.

## PART 3 - EXECUTION

### 3.1 GENERAL ELECTRICAL INSTALLATIONS

- A. The Contractor shall provide all necessary items for a complete operating system.
- B. Provide all electrical systems required by and in accordance with Division 26.
- C. Perform work for other divisions as required for electrical installations or coordinate such work with other trades which includes but is not necessarily limited to:
  - 1. Division 1: Cutting and Patching, Temporary Controls, Submittals, Facility Start-up, Contract Close Out, Record Documents, etc.
  - 2. Division 2: Trenching, Backfilling, Compaction, Demolition, etc.
  - 3. Division 3: Concrete Formwork.
  - 4. Division 5: Metal Fabrications.
  - 5. Division 6: Rough Carpentry.
  - 6. Division 7: Joint Sealers and Fire Stopping
  - 7. Division 8: Electric Door Hardware and Access Doors
    - a. Deviation: Contractor is encouraged to coordinate and combine electrical access with mechanical access, and has the option to not add electrical access panels if acceptable coordination can be achieved.
  - 8. Division 9 - Painting: In addition to Division 9, paint electrical equipment factory applied paint surfaces damaged during installation with paint purchased from equipment manufacturer to match each damaged surface.
  - 9. Divisions 11 and 13: Laboratory Furniture, Electronic Systems, Intercoms, etc.
  - 10. Division 15 for motors, controls, accessories, and connections.
- D. Verify all dimensions by field measurements.
- E. Arrange for chases, sleeve, slots, and openings in other building components during progress of construction, to allow for electrical installations.

- F. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
- G. Where mounting heights or locations are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom and working clearances possible, but not less than required by Code.
- H. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings and manufacturer's instructions, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Architect.
- I. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components, where installed exposed in finished spaces.
- J. Install electrical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. As much as practical, connect equipment for ease of disconnecting, with minimum of interference with other installations.
- K. Install J-boxes for all other equipment requiring access or maintenance, which are concealed behind surfaces so that these devices can be serviced from the access panels. Where practical, group J-boxes and equipment so that they can be accessed from the same panel or door. If additional panels are needed, panels must be submitted for approval.
- L. Cut, remove and legally dispose of selected electrical equipment, components, and materials, including but not limited to removal of electrical items indicated to be removed and items made obsolete by the new work.
- M. The A/E reserves the right to make relocations up to 6 feet of outlets, boxes, cabinets, lighting, etc. before finished rough-in at no cost to the Owner.
- N. Contractor shall notify design prime consultant and associated owner representative when he requests an inspection by the City Inspector.

### **3.2 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATIONS**

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.

### **3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
  - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

### **3.4 SLEEVE-SEAL INSTALLATION**

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.5 FIRESTOPPING**

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

### **3.6 PRODUCT DELIVERY, STORAGE AND HANDLING**

- A. Protection and Identification: Deliver products to project properly identified with names, model numbers, types, grades, compliance labels and similar information needed for distinct identification; adequately packaged or protected to prevent deterioration during shipment, storage and handling. Store in dry, well ventilated, indoor space, except where prepared and protected by manufacturer specifically for exterior storage.

### **3.7 DAMAGED EQUIPMENT**

- A. The following will be rejected (even after final installation) and must be replaced with same as original at no cost to Owner:
  - 1. Dented, deformed, stepped-on, or otherwise physically damaged enclosures.
  - 2. Stripped cover plate screws and the holes they screw into.
  - 3. Door hinges that do not operate smoothly.
- B. The following will require field repair to original condition:
  - 1. Minor scratches to equipment enclosure finishes.

### **3.8 TEMPORARY WIRING**

- A. The electrical Contractor shall arrange for and provide all necessary equipment, outlets, temporary lights, metering and communications as required during the construction period for temporary electrical service to the project.
- B. It shall be the responsibility of the electrical Contractor to consult with all other trades on the project in order to determine the voltage of temporary electrical service required to operate the construction equipment to be employed and to provide such services to the project.
- C. It shall be the responsibility of the electrical Contractor to make all arrangements for, and to furnish and install, any and all temporary wiring, switches, and structures which may be required to maintain service continuity during the entire construction period. Temporary power and lights shall be UL listed and shall include a ground wire, a guard and a proper means of support.
- D. All temporary installations shall be performed in accordance with the current edition of the National Electrical Code. All machinery and equipment powered by electricity shall have effective electrical equipment grounding provided with all electrical circuits.

### **3.9 UTILITIES**

- A. This Contractor shall examine the site and shall verify, to his own satisfaction, the location and elevation of all utilities, and shall adequately inform himself as to their relation to the work before entering into a contract.
- B. Existing utility lines shown within the scope of this project to be abandoned or removed shall be performed as directed by the Owner, and/or utility companies.
- C. Existing utility lines not shown on the drawings but encountered during construction shall be protected, relocated or capped as directed by the Owner, and/or utility companies. All

precautions shall be exercised to prevent damage to existing lines not shown, but should work become necessary, it must be authorized prior to execution except in an emergency situation.

- D. Before beginning excavations of any nature whatsoever, the Contractor shall make an attempt to locate all underground utilities of every nature occurring within the bounds of the area to be excavated. The Contractor shall then proceed with caution in his excavation work so that no utility shall be damaged with a resultant loss of service.
- E. Should any damage result to any utility through the Contractor's negligence or failure to comply with the above directive, he will be liable for such damage and for all expense incurred in the expeditious repair or replacement of such damaged utilities.
- F. Repair of damaged utilities shall be to a condition equal to or better than the adjacent undamaged portion of such utility and to the complete satisfaction of the Owner and/or utility companies.

### **3.10 EXCAVATION**

- A. The Contractor shall perform all excavation of every description and of whatever substances encountered, to the depths indicated and/or required for the installation of all portions of the utilities systems. All excavated materials not required for fill or backfill shall be removed. All excavation shall be made by open cut. The banks of trenches shall be kept as nearly vertical as practicable and where required shall be properly shored and braced. Trenches shall be at least 12" wider and not more than 16" wider than the outside diameter of the conduit, and shall be excavated true to line so that a clear space greater than 6" and less than 8" in width is provided on each side of the conduit or duct bank.
- B. Except at locations where the excavation of rock from bottom of trenches is required, care shall be taken not to excavate below the depths indicated. Where rock excavation is required, the rock shall be excavated to a minimum over-depth of 4" below the trench depths indicated on the drawings or as specified. The over-depth rock excavation shall be back-filled with loose, moist earth and thoroughly tamped.
- C. Whenever wet or otherwise unstable soil that is incapable of supporting the conduit duct bank, pole base or pad is encountered in the trench bottom, such soil shall be removed to a depth required. The trench bottom shall be filled with course sand, fine gravel, or other suitable material.
- D. Backfill with earth under pole bases, pads or other buried structures will not be permitted, and any unauthorized excess excavation below the levels indicated for foundation of such structures shall be filled with sand, gravel or concrete at the expense of the Contractor.
- E. All grading in the vicinity of excavations shall be controlled to prevent surface ground water from flowing into the excavations. Any water accumulated in the excavations shall be removed by pumping or by other approved method. During excavation, material suitable for backfilling shall be stacked in an orderly manner a sufficient distance back from the edges of trenches to avoid overloading and to prevent slides or cave-ins.

### **3.11 BACK-FILLING**

- A. Trenches shall not be back filled until all required tests are performed and until the utilities systems as installed conform to the requirements specified.
- B. Trenches shall be carefully back filled with the excavated materials approved for back filling. This material shall consist of earth, loam, sandy clay, sand and gravel, soft shale, or other

approved materials, free from large clods of earth or stones, deposited in thoroughly and carefully tamped 6" layers, until the conduit has a cover as specified. Broken rock, broken concrete or pavement, and large boulders shall not be used as backfill material.

- C. Settling the backfill with water will be permissible and will be a requirement when so directed.
- D. Any trenches across roadways or other areas to be paved shall be back filled with flowable fill (CLSM) or approved equal (ashes combined with concrete) in such manner as to permit the rolling and compaction of the filled trench. Together with the adjoining earth, shall provide required bearing value so that paving of the area can proceed immediately after the backfilling is completed.

### **3.12 CLOSEOUT PROCEDURES**

- A. General Coordination: Refer to Division 01 sections and individual Specification sections for coordination of electrical closeout work with variable loads on electrical system. Coordinate taking of final photographs (if any) with electrical closeout, so that maximum detail of work as finally accepted is shown. Sequence closeout procedures properly, so that work will not be endangered or damaged, and so that every required performance will be fully tested and demonstrated.
- B. System Performance Test Runs: Coordinate test runs of electrical systems with test runs of equipment served thereby (heating, air conditioning, plumbing, etc.). Check each item in each system to determine that it is set for proper operation. With Owner's Representative and Engineer present, operate each system in test run of appropriate duration to demonstrate compliance with performance requirements. During or following test runs, make final corrections or adjustments of systems to refine and improve performances where possible, including noise and vibration reductions, elimination of hazards, better response of controls, signals and alarms, and similar system performance improvements. Provide testing or inspection devices as may be reasonably requested for Engineer's observation of actual system performances. Demonstrate that controls and items requiring service or maintenance are accessible.
- C. Cleaning and Lubrication: After final performance test run of each electrical system, clean system both externally and internally. Comply with manufacturer's instructions for lubrication of both power and hand-operated equipment, and remove excess lubrication. Touch-up minor damage to factory-painted finishes and other painting specified as electrical work; refinish work where damage is extensive.
- D. General Operating Instructions: In addition to specific training of Owner's operating personnel specified in individual Division 26 work sections, and in addition to preparation of written operating instructions and compiled maintenance manuals specified in Division-26 Sections and elsewhere in these specifications, provide general operating instructions for each operational system and equipment item of electrical work. Coordinate instructions with instructions for mechanical work, elevators and other equipment where associated with electrical systems or equipment.
  - 1. Describe each basic electrical system and functioning of its control system.
  - 2. Explain identification system, mimic diagrams, signals, actuators, sensors, alarms, telecommunication systems, and similar audio/visual provisions.
  - 3. Describe interfaces with mechanical equipment, including interlocks, sequencing, start-up, shut down, emergency, safety, system failure, security and similar provisions.
  - 4. Outline basic maintenance procedures and major equipment turnaround requirements, including adjustments to optimize output and efficiency of electrical system.

- 5. Display and conduct "thumb-through" explanation of maintenance manuals, record drawings, spare part inventory, storage of extra materials, meter readings and similar service items.
- E. Construction Equipment: After completion of performance testing and Owner's operating instructions and demonstrations, remove installer's tools, test facilities, construction equipment and similar devices and materials used in execution of work but not incorporated in work.
- F. Security and Protection: During electrical work closeout phase, meet with Owner's operating representative frequently (daily where necessary) and agree upon status of operational responsibility for electrical systems (including securing provisions to prevent unauthorized operations, and including protective measures to ensure that systems are not neglected or misused).

**PART 4 - CONTINUED SYSTEM OPERATIONS**

- A. Acceptance and Continued Services: Coordinate Owner's take-over of electrical systems with take-over of mechanical systems, including the provision of skilled electrical operating and maintenance personnel until time Owner's personnel take over operation of entire mechanical and electrical plant. Contractor shall continue consultation and services (beyond take-over date) for electrical systems, matching required continued services on associated mechanical systems and equipment.

END OF SECTION 26 05 00

**26 05 19**

**LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Building wires and cables rated 600V and less.
  - 2. Connectors, splices, and terminations rated 600V and less.
  - 3. Sleeves and sleeve seals for cables.
- B. Related Sections include the following:
- C. List below only products and equipment that the reader might expect to find in this Section but are specified elsewhere.
  - 1. Division 27.

**1.3 DEFINITIONS**

- A. Retain abbreviations that remain after this Section has been edited.
- B. EPDM: Ethylene-propylene-dieneterpolymer rubber.
- C. NBR: Acrylonitrile-butadiene rubber.
- D. MCM: Thousand circular-mils.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Coordinate paragraph below with qualification requirements in Division 01 Section "Quality Requirements" and as supplemented in "Quality Assurance" Article.
- C. Qualification Data: For testing agency.
- D. Retain paragraph below if Contractor is responsible for field quality-control testing.
- E. Field quality-control test reports.

**1.5 QUALITY ASSURANCE**

- A. Retain first paragraph and subparagraph below if Contractor is required to provide services of an independent testing agency in Part 3 "Field Quality Control" Article. Qualification

requirements supplement those specified in Division 01 Section "Quality Requirements", which also includes the definition for NRTL.

- B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- D. Comply with NFPA 70.
- E. UL Compliance: Provide components which are listed and labeled by UL under the following standards.
  - 1. UL Std. 83 - Thermoplastic-Insulated Wires and Cables.
  - 2. UL Std. 4 - Armored Cable
  - 3. UL Std. 1569 - Metal-Clad Cables
  - 4. UL Std. 486A - Wire Connectors and Soldering Lugs for Use with Copper Conductors.
  - 5. UL 13 - Power limited circuit cables.
  - 6. UL 1666 - Test for flame propagation height of electrical and optical-fiber cables installed vertically in shafts.
  - 7. UL 910 - Test for flame propagation and smoke density values for and optical fiber cables used in spaces environmental air.
  - 8. UL 1685 - Vertical tray fire propagation and smoke release test for and optical fiber cables.
- F. NEMA WC-5: Thermoplastic-insulated wire and cable for the transmission and distribution of electrical energy.
- G. Federal Specifications
  - 1. J-C-30B (1) cable and wire, electrical (power, fixed installation).

## 1.6 COORDINATION

- A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

## PART 2 - PRODUCTS

### 2.1 CONDUCTORS AND CABLES

- A. Manufacturers, 600 Volt or Less Wire and Cable: Subject to compliance with requirements, provide products by one of the following:
  - 1. Encore Wire
  - 2. General Wire.
  - 3. South wire.
- B. Manufacturers, Low Voltage Wire (300V and under): Subject to compliance with requirements, provide products by one of the following
  - 1. Alpha.

2. Belden.
3. West Penn.

- C. Copper Conductors: Comply with NEMA WC 70.
- D. Conductor Insulation: Comply with NEMA WC 70 for Types THW, THHN-THWN, XHHW, UF, USE and SO. All conductors are to be Copper wire or cable insulated for 600 V, color coded for the entire length. Use of electrical tape for marking is strictly prohibited.
1. Conductors shall be provided with insulation types indicated explicitly on drawings, and substitution is NOT acceptable without Engineer's approval.
  2. Wiring BX and MC will not be acceptable for use on this project. MC may be used for light fixture whips only.
  3. Where insulation type is not explicitly identified on drawings, branch circuit and feeder circuit conductors shall have THHN-THWN dual-rated insulation.
- E. Multi-conductor Cable: Comply with NEMA WC 70 for armed cable, Type AC, metal clad cable, Type MC, mineral-insulated, sheathed cable, Type MI with ground wire.

## 2.2 CONNECTORS AND SPLICES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems, Inc.
  2. Hubbell Power Systems, Inc.
  3. O-Z/Gedney; EGS Electrical Group LLC.
  4. 3M; Electrical Products Division.
  5. Tyco Electronics Corp.
- C. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

## 2.3 SLEEVES FOR CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral water stop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

## 2.4 SLEEVE SEALS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:

1. Advance Products & Systems, Inc.
2. Calpico, Inc.
3. Metraflex Co.
4. Pipeline Seal and Insulator, Inc.

- C. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

### **PART 3 - EXECUTION**

#### **3.1 CONDUCTOR MATERIAL APPLICATIONS**

- A. Copper:
1. Solid for #10 AWG and smaller;
  2. Stranded for #8 AWG and larger.
- B. Aluminum:
1. Use only for distribution or service feeders where explicitly indicated on Drawings.
  2. Use AA-8030 alloy only.
  3. Stranded only
  4. Minimum size: 250 MCM.
  5. Provide compression lugs.

#### **3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS**

- A. Service Entrance: Type XHHW-2 single conductors in raceway, unless specifically noted otherwise on Drawings.
- B. Feeders to Switch Boards, Distribution-Class Panels, and Motor Control Centers located in central plant or main electrical room: Type XHHW-2 single conductors in raceway, unless specifically noted otherwise on Drawings.
- C. Feeders to Distribution-Class Panels, Lighting-Class Panels, and distribution equipment located in any other area: Type THHN/THWN-2 dual-rated insulation conductors in raceway, unless specifically noted otherwise on Drawings.
- D. Feeders to Emergency Equipment: Type RHW-2, unless specifically noted otherwise on Drawings.
- E. Branch Circuits: Type THHN/THWN-2 dual-rated insulation conductors in raceway, unless specifically noted otherwise on Drawings.
1. Lighting Fixture Tails: A maximum of 6'-0" length of multi-conductor cable may be used for lighting fixture connection from above-ceiling junction boxes with Code-required support and minimum of one support point between junction box and fixture.
  2. Wiring Devices: Multi-conductor cable is not acceptable for use in connection of wiring devices and associated boxes.
  3. Equipment: Multi-conductor cable is not acceptable for use in connection of equipment by any Division.
- F. Control Circuits: Type THHN/THWN-2 in raceway.

#### **3.3 INSTALLATION OF CONDUCTORS AND CABLES**

- A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

- B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
- C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway. Do not re-pull wires/conductors that been used. Do not use rope hitches for pulling attachment to wire or cable.
- D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."
- F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."
- G. All wire shall be installed in conduit or raceways.
- H. All circuits shall have a hot, neutral and green ground wire unless otherwise indicated.
- I. Provide #12 conductors and #12 grounds minimum to all 20 amp devices unless otherwise indicated.
- J. Provide #10 conductors and #10 grounds minimum to all 30 amp devices unless otherwise indicated.
- K. Provide #10 minimum conductors for 20 amp circuits  $\leq$  150 VAC line-to-neutral for which the distance from the panelboard to the first device is greater than 100 feet.
- L. Provide #10 minimum conductors for 20 amp circuits  $>$  150 VAC line-to-neutral for which the distance from the panelboard to the first device is greater than 200 feet.
- M. Do not install wires in conduit until entire system of conduit and outlet boxes is permanently in place.
- N. Exercise care when installing wire in conduit so as to prevent injury to the conductor insulation. Mechanical means of pulling shall not be used unless approved. Conductors shall be pulled using UL non-flammable listed lubricant when necessary. Do not re-pull wires/conductors that been used.
- O. Whenever wiring leaves the conduit and terminates at a terminal board, the wiring shall be formed and laced with plastic wire ties. Conductors are to be installed neat, order and workmanlike manner and also comply per NEC 70; Article 312.
- P. In the event circuits feed through outlet boxes, provide splice and pigtail for device connection, with sufficient slack to pull splice out of box at least 6 inches (for inspection). Terminate the conductors around the terminal screws not at the back of the receptacle.
- Q. Coordinate cable installation with other Work.
- R. Pull conductors simultaneously where more than one is being installed in same raceway.
- S. Splices:
  - 1. Branch Circuits: Keep conductor splices to a minimum.
  - 2. Motor Branch Circuits: Splices are not allowed in motor branch circuit feeders.

3. Relocation of Existing Lighting-Class Panels: Provide splices to existing branch circuits that are active and will remain in above-ceiling junction boxes sized appropriately for the quantity of conductors. Verify existing branch circuit feeder condition and ampacity and provide new feeders where existing violations exist. Match and extend branch circuit feeders from splice to new panel location and provide new branch circuit breaker as indicated in Panel Schedules to re-feed existing load.
  4. Service Entrance Feeders: Splices are not allowed in any service entrance feeder(s). All conductors must be single length.
  5. Distribution Feeders: Splices are not allowed in any distribution feeder(s) including, but not limited to feeders between switch boards, distribution-class panels, lighting-class panels, motor control centers, transformers, safety switches, and motor controllers and drives.
  6. Install splice and tap connectors which possess equivalent or better mechanical strength and insulation rating than conductors being spliced.
  7. Use splice and tap connectors which are compatible with conductor material.
- T. Provide adequate length of conductors within electrical enclosures and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than no.10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.
- U. Home Runs: except where specifically indicated, provide lighting branch circuit home runs with not more than three different line conductors and a common neutral in a single raceway for 4-wire, 3-phase systems.
- V. Conductors may be run in parallel in sizes 1/0 through 750 MCM where indicated and provided that all conductors of each phase are the same length and so arranged and terminated as to ensure equal division of the current between all paralleled phase conductors.
- W. Feeders shall be installed in continuous pieces without splice.
- X. Install a separate neutral for each circuit which serves GFCI or isolated ground receptacles.
- Y. Each circuit originating from a GFCI type circuit breaker shall also have a separate neutral.
- Z. Where specifically indicated, for receptacle branch circuits, provide a separate neutral conductor for each line conductor.
- AA. Each circuit serving receptacles where data terminals are used shall have separate neutral.

### **3.4 CONNECTIONS**

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B. Provide Documentation and records all torque terminations.
- B. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack per Section 300.14.

### **3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS**

- A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Rectangular Sleeve Minimum Metal Thickness:
  - 1. For sleeve rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.
  - 2. For sleeve rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.
- E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- F. Cut sleeves to length for mounting flush with both wall surfaces.
- G. Extend sleeves installed in floors 2 inches above finished floor level.
- H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and cable unless sleeve seal is to be installed.
- I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.
- J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."
- K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."
- L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.
- M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between cable and sleeve for installing mechanical sleeve seals.

### **3.6 SLEEVE-SEAL INSTALLATION**

- A. Install to seal underground exterior-wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

### **3.7 FIRESTOPPING**

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

### **3.8 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors, and conductors feeding the following critical equipment and services for compliance with requirements.
  - 2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 3. Perform insulation resistance test for all branch and main circuit conductor. Perform test on each conductor with respect to ground and adjacent conductor. Applied potential shall be 1000 volts DC for one minute. Test values shall be evaluated and conductors with values less than 50 megohms shall be investigated. Replace any cable reading less than 1 megohm.
  - 4. Provide torque test for all conductor terminations in transformers, switchboards; disconnect switches, panelboards, etc in accordance with NETA standards. Record test result in accordance with item D below.
  - 5. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each termination of cables and conductors No. 3 AWG and larger. Remove box and equipment covers so terminations are accessible to portable scanner.
    - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
    - b. Record of Infrared Scanning: Prepare a certified report that identifies terminations checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- C. Test Reports: Prepare a written report to record the following:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
- D. Remove and replace malfunctioning units and retest as specified above.
- E. Cleaning:
  - 1. Clean the area around and on top of the equipment.

**END OF SECTION 26 05 19**

**26 05 26**

**GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
  - 1. Underground distribution grounding.
  - 2. Common ground bonding with lightning protection system.

**1.3 SUBMITTALS**

- B. Product Data: For each type of product indicated.
- A. Product Samples: Only for Ground Rods, provide one to Engineer for approval to be turned over to Owner as attic stock after substantial completion.
- B. Retain paragraph and subparagraphs below to require that Contractor provide drawings to locate significant grounding features. Division 01 Sections "Project Record Documents" and "Operation and Maintenance Data" require submittals to be included in those documents for use by maintenance forces throughout the life of the Project.
- C. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
  - 1. Test wells.
  - 2. Ground rods.
  - 3. Ground rings.
  - 4. Grounding arrangements and connections for separately derived systems.
  - 5. Grounding for sensitive electronic equipment.
- D. Qualification Data: For testing agency and testing agency's field supervisor.
- E. Field quality-control test reports.
- F. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
  - 1. Instructions for periodic testing and inspection of grounding features at ground rings grounding connections for separately derived systems based on NFPA 70B.
    - a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.
    - b. Include recommended testing intervals.
    - c. Records documentation is required for all testing.

## 1.4 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience, certified and capability to conduct the testing indicated, that is a member company of the International Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
  - 1. Testing Agency's Field Supervisor: Person currently certified by the International Electrical Testing Association to supervise on-site testing specified in Part 3.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with UL 467 for grounding and bonding materials and equipment.

## PART 2 - PRODUCTS

### 2.1 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

- A. Acceptable Manufacturers: Erico, Copper weld, Cad weld, Bundy

### 2.2 CONDUCTORS

- A. Insulated Conductors: All conductors are to be Copper wire or cable insulated for 600 V,color coded for the entire length. Use of electrical tape for marking is strictly prohibited.
- B. Bare Copper Conductors: Only where specifically indicated on Drawings.
  - 1. Solid Conductors: ASTM B 3.
  - 2. Stranded Conductors: ASTM B 8.
  - 3. Tinned Conductors: ASTM B 33.
  - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor and 1/4 inch in diameter.
  - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
  - 6. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
  - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Bare Grounding Conductor and Conductor Protector for Wood Poles:
  - 1. No. 4 AWG minimum, soft-drawn copper.
  - 2. Conductor Protector: Half-round PVC or wood molding. If wood, use pressure-treated fir or cypress or cedar.
- D. Grounding Bus: Rectangular bars of annealed copper, 1/4 by 2 inches in cross section, unless otherwise indicated; with insulators.

### 2.3 CONNECTORS

- A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.
- B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
  - 1. Pipe Connectors: Clamp type, sized for pipe.

- C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

## 2.4 GROUNDING ELECTRODES

- D. Ground Rods: Copper-bonded steel; 3/4 inch diameter by 10 feet length; minimum 13 mil plating thickness.

## PART 3 - EXECUTION

### 3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger, unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned copper conductor, No. 2/0 AWG minimum.
  - 1. Bury at least 24 inches below grade.
  - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.
- D. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
  - 1. Install bus on insulated spacers 1 inch, minimum, from wall 6 inches above finished floor, unless otherwise indicated.
  - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, down to specified height above floor, and connect to horizontal bus.
  - 3. Install grounding conductor from main service to the grounding bus. The minimum conductor used per Article 250.
- E. Conductor Terminations and Connections:
  - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
  - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
  - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
  - 4. Connections to Structural Steel: Welded connectors.

### 3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, non-shrink grout.

- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

### 3.3 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
  - 1. Feeders and branch circuits.
  - 2. Lighting circuits.
  - 3. Receptacle circuits.
  - 4. Single-phase motor and appliance branch circuits.
  - 5. Three-phase motor and appliance branch circuits.
  - 6. Flexible raceway runs.
  - 7. Armored and metal-clad cable runs.
  - 8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
  - 9. Computer and Rack-Mounted Electronic Equipment Circuits: Install insulated equipment grounding conductor in branch-circuit runs from equipment-area power panels and power-distribution units.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Anti-frost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.
- B. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service, unless otherwise indicated.

- F. Signal and Communication Equipment: For telephone, alarm, voice and data, and other communication equipment, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
  - 1. Service and Central Equipment Locations and Wiring Closets: Terminate grounding conductor on a 1/4-by-2-by-12-inch grounding bus.
  - 2. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.
- G. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

### 3.4 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Common Ground Bonding with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
  - 1. Use same-manufacturer, matched driving tool to drive ground rods without deformation. "Mushroomed" or otherwise deformed rods will be field-rejected.
  - 2. Replace grounding rods that are deformed at no cost to Owner.
  - 3. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated.
  - 4. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Division 26 Section "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
  - 1. Test Wells: Install at least one test well for each service, unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
  - 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
  - 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
  - 3. Use exothermic-welded connectors for outdoor locations, but if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
  - 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service

- entrances to building. Connect grounding conductors to main metal water service pipes, using a bolted clamp connector or by bolting a lug-type connector to a pipe flange, using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
  3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each indicated item, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
  2. Bury ground ring not less than 24 inches from building foundation.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
- B. Perform the following tests and inspections and prepare test reports:
1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
  2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal and at individual ground rods. Make tests at ground rods before any conductors are connected.
    - a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
    - b. Perform tests by fall-of-potential method according to IEEE 81.
  3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- C. Report measured ground resistances that exceed the following values:
1. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 1  $\Omega$ .
  2. Power Distribution Units or Panelboards Serving Electronic Equipment: 0.5  $\Omega$ .
  3. Substations and Pad-Mounted Equipment: 0.5  $\Omega$ .
  4. Manhole Grounds: 5  $\Omega$ .
- D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

**END OF SECTION 26 05 26**

**26 05 29**

**HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Follow and comply with SMSD MEP Electrical Standards.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Hangers and supports for electrical equipment and systems.
  - 2. Construction requirements for concrete bases.

**1.3 DEFINITIONS**

- A. Retain abbreviations that remain after this Section has been edited.
- B. EMT: Electrical metallic tubing.
- C. IMC: Intermediate metal conduit.
- D. RMC: Rigid metal conduit.

**1.4 PERFORMANCE REQUIREMENTS**

- A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

**1.5 SUBMITTALS**

- A. Product Data: For the following:
  - 1. Steel slotted support systems.
  - 2. Nonmetallic slotted support systems.

- 
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
    - 3. Trapeze hangers. Include Product Data for components.
    - 4. Steel slotted channel systems. Include Product Data for components.
    - 5. Nonmetallic slotted channel systems. Include Product Data for components.
    - 6. Equipment supports.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Comply with NFPA 70.

## 1.7 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

## PART 2 - PRODUCTS

### 2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Retain this Article to specify default product requirements for basic supporting devices. Items to be supported include raceways, cables, wireways, cable trays, busways, boxes, cabinets, equipment, and other electrical products. Where support materials or workmanship is unique to a particular product, specify unique features that are the exception to these default requirements in the Section that specifies the product. Coordinate specifications for supporting devices with structural engineer and with Drawings.
- B. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
  - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. ERICO International Corporation.
    - d. Thomas & Betts Corporation.
    - e. Unistrut; Tyco International, Ltd.
  - 2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
  - 3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
  - 4. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
  - 5. Channel Dimensions: Selected for applicable load criteria.
- C. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch diameter holes at a maximum of 8 inches o.c., in at least 1 surface.

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6. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  7. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Allied Tube & Conduit.
    - b. Cooper B-Line, Inc.; a division of Cooper Industries.
    - c. Fabco Plastics Wholesale Limited.
  8. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.
  9. Fitting and Accessory Materials: Same as channels and angles except metal items may be stainless steel.
  10. Rated Strength: Selected to suit applicable load criteria.
- D. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- E. Conduit and Cable Support Devices: Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- F. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.
- G. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
- H. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
11. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Hilti Inc.
      - 2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 3) MKT Fastening, LLC.
      - 4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
  12. Mechanical-Expansion Anchors: Insert-wedge-type, steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
    - a. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - b. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      - 1) Cooper B-Line, Inc.; a division of Cooper Industries.
      - 2) Empire Tool and Manufacturing Co., Inc.
      - 3) Hilti Inc.
      - 4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
      - 5) MKT Fastening, LLC.

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13. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
  14. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
  15. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
  16. Toggle Bolts: All-steel springhead type.
  17. Hanger Rods: Threaded steel.

## **2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES**

- A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

## **PART 3 - EXECUTION**

### **3.1 APPLICATION**

- C. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
  1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.
- G. All conduits shall be installed in uniformity, neat and equal space.

### **3.2 SUPPORT INSTALLATION**

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

- 
1. To Wood: Fasten with lag screws or through bolts.
  2. To New Concrete: Bolt to concrete inserts.
  3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
  4. To Existing Concrete: Expansion anchor fasteners.
  5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
  6. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
  7. To Light Steel: Sheet metal screws.
  8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

### **3.3 INSTALLATION OF FABRICATED METAL SUPPORTS**

- A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

### **3.4 CONCRETE BASES**

- A. Construct concrete bases of dimensions indicated but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.
- B. Use 3000-psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base.
  1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  2. Install anchor bolts to elevations required for proper attachment to supported equipment.
  3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

### **3.5 PAINTING**

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

**END OF SECTION 26 05 29**

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**26 05 53**

**IDENTIFICATION FOR ELECTRICAL SYSTEMS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Identification for raceways.
  - 2. Identification of power and control cables.
  - 3. Identification for conductors.
  - 4. Underground-line warning tape.
  - 5. Warning labels and signs.
  - 6. Instruction signs.
  - 7. Equipment identification labels.
  - 8. Miscellaneous identification products.
  - 9. Identification of Boxes, Junction Boxes and Pull Boxes
  - 10. Identification of Switchboards, Motor Control Center, Panelboard, transformers, disconnecting means, Timer and etc.

**1.3 SUBMITTALS**

- A. Product Data: For each electrical identification product indicated.
- B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions riveted to the metal surface, and graphic features of identification products.
- A. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

**1.4 QUALITY ASSURANCE**

- A. Comply with ANSI A13.1.
- A. Comply with NFPA 70.
- B. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- C. Comply with ANSI Z535.4 for safety signs and labels.
- B. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

## 1.5 COORDINATION

- A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.
- B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- C. Coordinate installation of identifying devices with location of access panels and doors.
- D. Install identifying devices before installing acoustical ceilings and similar concealment.

## PART 2 - PRODUCTS

### 2.1 POWER RACEWAY IDENTIFICATION MATERIALS

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.
- B. Colors for Raceways Carrying Circuits at 600 V or Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- C. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 1. Black letters on an orange field.
  - 2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- D. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- E. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- F. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- G. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch-wide black stripes on 10-inch centers diagonally over orange background that extends full length of raceway or duct and is 12 inches wide. Stop stripes at legends.
- H. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- I. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

## **2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- A. Colors for Raceways Carrying Circuits at 600 V and Less:
  - 1. Black letters on an orange field.
  - 2. Legend: Indicate voltage and system or service type.
- B. Colors for Raceways Carrying Circuits at More Than 600 V:
  - 3. Black letters on an orange field.
  - 4. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING" with 3-inch- high letters on 20-inch centers.
- B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- C. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

## **2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS**

- A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.
- A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- B. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
- B. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- C. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Snap-Around, Color-Coding Bands: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

## **2.4 CONDUCTOR IDENTIFICATION MATERIALS**

- A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

- A. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.
- B. Snap-Around Labels: Slit, pre-tensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- C. Snap-Around, Color-Coding Bands: Slit, pre-tensioned, flexible, solid-colored acrylic sleeve, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.
- D. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
- B. Write-On Tags: Polyester tag, 0.010 inch thick, with corrosion-resistant grommet and cable tie for attachment to conductor or cable.
  - 1. Marker for Tags: Permanent, waterproof, black ink marker recommended by tag manufacturer.
  - 2. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.
- E. All conductors shall have the color of insulation for the entire length. Do not use electrical tape to identify the colors. This applies in all sizes.

## **2.5 FLOOR MARKING TAPE**

- A. 2-inch- wide, 5-mil pressure-sensitive vinyl tape, with black and white stripes and clear vinyl overlay.

## **2.6 UNDERGROUND-LINE WARNING TAPE**

- A. Tape:
  - 1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
  - 2. Printing on tape shall be permanent and shall not be damaged by burial operations.
  - 3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
- A. Color and Printing:
  - 4. Comply with ANSI Z535.1 through ANSI Z535.5.
  - 5. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE.
  - 6. Inscriptions for Orange-Colored Tapes: TELEPHONE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

## **2.7 WARNING LABELS AND SIGNS**

- A. Comply with NFPA 70 and 29 CFR 1910.145.
- A. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.
- B. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch grommets in corners for mounting.
3. Nominal size, 7 by 10 inches.

C. Warning label and sign shall include, but are not limited to, the following legends:

D. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

## **2.8 EQUIPMENT IDENTIFICATION LABELS**

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. No adhesive is strictly prohibited.

B. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch. Overlay shall provide a weatherproof and UV-resistant seal for label. No adhesive is strictly prohibited.

C. Punch or drilled riveted Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch. No adhesive is strictly prohibited.

D. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch. No adhesive is strictly prohibited.

A. Stenciled Legend: In non-fading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

E. Only use drilled/punched riveted label on equipment.

## **2.9 CABLE TIES**

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 12,000 psi.
3. Temperature Range: Minus 40 to plus 185 deg F.
4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one-piece, self-locking.

1. Minimum Width: 3/16 inch.
2. Tensile Strength at 73 deg F, According to ASTM D 638: 7000 psi.
3. UL 94 Flame Rating: 94V-0.
4. Temperature Range: Minus 50 to plus 284 deg F.

5. Color: Black.

## **2.10 MISCELLANEOUS IDENTIFICATION PRODUCTS**

- A. Paint: Comply with requirements in Division 09 painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Verify identity of each item before installing identification products.
- B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.
- C. Apply identification devices to surfaces that require finish after completing finish work.
- D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.
- E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
- F. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or cable at a location with high visibility and accessibility.
- H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:
1. Outdoors: UV-stabilized nylon.
  2. In Spaces Handling Environmental Air: Plenum rated.
- I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches overall.
- J. Painted Identification: Comply with requirements in Division 09 painting Sections for surface preparation and paint application.

### **3.2 IDENTIFICATION SCHEDULE**

- A. Identification of Electrical Systems
1. Identify all equipment and circuit breakers.
  2. Identify all J-box covers with circuit numbers.

3. On all device wall plates, on inside of plate, indicate panel and circuit number feeding the device.
  4. All electrical panels shall have type written panel schedule with room descriptions using actual room signage numbers.
  5. Electrical systems shall be identified by painted junction boxes and covers with the following scheme:
    - a. Lighting system: Yellow
    - b. Emergency Power: Red
    - c. 120V Power: Blue
    - d. HVAC system power: Green
  6. Electrical panel identification shall include the following:
    - a. Panel Name
    - b. Voltage
    - c. Amperage
    - d. General description such as: Lighting Area A or Power Area C. Refer to Drawings.
    - e. Appropriately colored for emergency.
    - f. Feeder panel designation must be clearly identified.
- B. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 10-foot maximum intervals.
- C. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:
  1. Emergency Power.
  2. Power.
- D. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and hand-holes, use color-coding conductor tape to identify the phase.
  1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder, and branch-circuit conductors.
    - a. New Conductors: Insulation shall be fully and continuously colored. Phase taping is not acceptable.
    - b. Colors for 208/120-V Circuits:
      - 1) Phase A: Black.
      - 2) Phase B: Red.
      - 3) Phase C: Blue.
      - 4) Neutral: White
      - 5) Ground: Green
    - c. Colors for 480/277-V Circuits:
      - 1) Phase A: Brown.
      - 2) Phase B: Purple
      - 3) Phase C: Yellow.
      - 4) Neutral: Gray/White
      - 5) Ground: Green
- E. Install instructional sign including the color code for grounded and ungrounded conductors using adhesive-film-type labels.
- F. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- G. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
  2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
  3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.
- H. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
  2. Install underground-line warning tape for both direct-buried cables and cables in raceway.
- I. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
  2. Identify system voltage with black letters on an orange background.
  3. Apply to exterior of door, cover, or other access.
  4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
    - a. Power transfer switches.
    - b. Controls with external control power connections.
- K. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.
- L. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- high letters for emergency instructions at equipment used for power transfer.
- M. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions:
    - a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- high letters on 1-1/2-inch- high label; where two lines of text are required, use labels 2 inches high.
    - b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
    - c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    - d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.
  2. Equipment to Be Labeled: Use punched, drilled riveted label or identifications

- a. Panelboards: Typewritten hard thick card stock paper directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be laminated acrylic or melamine label.
- b. Enclosures and electrical cabinets.
- c. Access doors and panels for concealed electrical items.
- d. Switchboards.
- e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
- f. Substations.
- g. Emergency system boxes and enclosures.
- h. Motor-control centers.
- i. Enclosed switches.
- j. Enclosed circuit breakers.
- k. Enclosed controllers.
- l. Variable-speed controllers.
- m. Push-button stations.
- n. Power transfer equipment.
- o. Contactors.
- p. Remote-controlled switches, dimmer modules, and control devices.
- q. Battery-inverter units.
- r. Battery racks.
- s. Power-generating units.
- t. Monitoring and control equipment.

**END OF SECTION 26 05 33**

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**26 05 73**

**OVERCURRENT PROTECTIVE DEVICE COORDINATION AND ARC FLASH STUDY**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Follow and comply with the SMSD MEP Electrical Standards.

**1.2 SUMMARY**

- A. This Section includes computer-based, fault-current, overcurrent protective device coordination selective studies, and arc flash study. Protective devices shall be set based on results of the protective device coordination selective study.
  - 1. Coordination of series-rated devices is permitted where indicated on Drawings.
  - 2. Retain a qualified professional/engineering firm to assist in the development and implementation of the arc flash and protection coordination selective study.

**1.3 SUBMITTALS**

- A. Product Data: For computer software program to be used for studies.
- B. Product Certificates: For coordination-study and fault-current-study computer software programs, certifying compliance with IEEE 399.
- C. Qualification Data: For coordination-selective study specialist.
- D. Other Action Submittals: The following submittals shall be made after the approval process for system protective devices has been completed. Submittals may be in digital form.
  - 1. Coordination- selective study input data, including completed computer program input data sheets.
  - 2. Study and Equipment Evaluation Reports.
  - 3. Coordination- Selective Study Report.
  - 4. Electrical One-line diagram

**1.4 QUALITY ASSURANCE**

- A. Studies shall use computer programs that are distributed nationally and are in wide use. Software algorithms shall comply with requirements of standards and guides specified in this Section. Manual calculations are not acceptable.
- B. Coordination- Selective Study Specialist Qualifications: An entity experienced in the application of computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
  - 1. Professional engineer, licensed in the state where Project is located, shall be responsible for the study. All elements of the study shall be performed under the direct supervision, SMSD representative.
- C. Comply with IEEE 242 for short-circuit currents and coordination time intervals.

- D. Comply with IEEE 399 for general study procedures.
- E. The entity shall have an employee that is certified, train and skilled to perform this type of test and be able to interpret the curve and settings.

## **PART 2 - PRODUCTS**

### **2.1 COMPUTER SOFTWARE DEVELOPERS**

- A. Available Computer Software Developers: Subject to compliance with requirements, companies offering computer software programs that may be used in the Work include, but are not limited to, the following:
- B. Computer Software Developers: Subject to compliance with requirements, provide products by one of the following:
- C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
  - 1. CGI CYME.
  - 2. EDSA Micro Corporation.
  - 3. ESA Inc.
  - 4. Operation Technology, Inc.
  - 5. SKM Systems Analysis, Inc.

### **2.2 COMPUTER SOFTWARE PROGRAM REQUIREMENTS**

- A. Comply with IEEE 399.
- B. Analytical features of fault-current-study computer software program shall include "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance. Devices to be coordinated are indicated on Drawings.
  - 1. Proceed with coordination selective study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

### **3.2 POWER SYSTEM DATA**

- A. Gather and tabulate the following input data to support coordination study:
  - 1. Product Data for overcurrent protective devices specified in other Division 26 Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Impedance of utility service entrance.
3. Electrical Distribution System Diagram: In hard-copy and electronic-copy formats, showing the following:
  - a. Circuit-breaker and fuse-current ratings and types.
  - b. Relays and associated power and current transformer ratings and ratios.
  - c. Transformer kilovolt amperes, primary and secondary voltages, connection type, impedance, and X/R ratios.
  - d. Generator kilovolt amperes, size, voltage, and source impedance.
  - e. Cables: Indicate conduit material, sizes of conductors, conductor material, insulation, and length.
  - f. Busway ampacity and impedance.
  - g. Motor horsepower and code letter designation according to NEMA MG 1.
4. Data sheets to supplement electrical distribution system diagram, cross-referenced with tag numbers on diagram, showing the following:
  - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
  - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
  - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
  - d. Generator thermal-damage curve.
  - e. Ratings, types, and settings of utility company's overcurrent protective devices.
  - f. Special overcurrent protective device settings or types stipulated by utility company.
  - g. Time-current-characteristic curves of devices indicated to be coordinated.
  - h. Manufacturer, frame size, interrupting rating in amperes rms symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
  - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
  - j. Panelboards, switchboards, motor-control center ampacity, and interrupting rating in amperes rms symmetrical.

### 3.3 FAULT-CURRENT STUDY

- A. Calculate the maximum available short-circuit current in amperes rms symmetrical at circuit-breaker positions of the electrical power distribution system. The calculation shall be for a current immediately after initiation and for a three-phase bolted short circuit at each of the following:
  1. Switchgear and switchboard bus.
  2. Medium-voltage controller.
  3. Motor-control center.
  4. Distribution panelboard.
  5. Branch circuit panelboard.
- B. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Include studies of system-switching configurations and alternate operations that could result in maximum fault conditions.
- C. Calculate momentary and interrupting duties on the basis of maximum available fault current.
- D. Calculations to verify interrupting ratings of overcurrent protective devices shall comply with IEEE 141, IEEE 241 and IEEE 242.
  1. Transformers:

- a. ANSI C57.12.10.
  - b. ANSI C57.12.22.
  - c. ANSI C57.12.40.
  - d. IEEE C57.12.00.
  - e. IEEE C57.96.
2. Low-Voltage Circuit Breakers: IEEE 1015 and IEEE C37.20.1.
  3. Low-Voltage Fuses: IEEE C37.46.
- E. Study Report:
1. Show calculated X/R ratios and equipment interrupting rating (1/2-cycle) fault currents on electrical distribution system diagram.
  2. Show interrupting (5-cycle) and time-delayed currents (6 cycles and above) on medium and high voltage breakers as needed to set relays and assess the sensitivity of overcurrent relays.
- F. Equipment Evaluation Report:
1. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
  2. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in the standards to 1/2-cycle symmetrical fault current.
  3. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.

### 3.4 COORDINATION SELECTIVE STUDY

- A. Perform coordination study using approved computer software program. Prepare a written report using results of fault-current study. Comply with IEEE 399.
1. Calculate the maximum and minimum 1/2-cycle short-circuit currents.
  2. Calculate the maximum and minimum interrupting duty (5 cycles to 2 seconds) short-circuit currents.
  3. Calculate the maximum and minimum ground-fault currents.
- B. Comply with IEEE 141 recommendations for fault currents and time intervals.
- C. Transformer Primary Overcurrent Protective Devices:
1. Device shall not operate in response to the following:
    - a. Inrush current when first energized.
    - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
    - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
  2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- D. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and conductor melting curves in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- E. Coordination-Selective Study Report: Prepare a written report indicating the following results of coordination study:
1. Tabular Format of Settings Selected for Overcurrent Protective Devices:

- a. Device tag.
- b. Relay-current transformer ratios; and tap, time-dial, and instantaneous-pickup values.
- c. Circuit-breaker sensor rating; and long-time, short-time, and instantaneous settings.
- d. Fuse-current rating and type.
- e. Ground-fault relay-pickup and time-delay settings.
2. Coordination Curves: Prepared to determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
  - a. Device tag.
  - b. Voltage and current ratio for curves.
  - c. Three-phase and single-phase damage points for each transformer.
  - d. No damage, melting, and clearing curves for fuses.
  - e. Cable damage curves.
  - f. Transformer inrush points.
  - g. Maximum fault-current cutoff point.
- F. Completed data sheets for setting of overcurrent protective devices.

### 3.5 ARC FLASH STUDY

- A. A detailed arc flash study shall be performed to determine potential arc flash incident energies, arc flash boundaries, shock hazard boundaries and proper personal protective equipment (PPE) for all energized electrical system equipment tasks for the electrical systems studied. The calculations shall comply with NFPA-70E 2009, and IEEE-1584. Bolted short circuit calculations used in the above standards shall comply with ANSI C37.010, C37.13, C37.5, IEEE-141, and IEEE-399. The purpose of this study is to determine arc flash hazards in conformance with NFPA-70E and to provide a comprehensive software model of the electrical distribution system, which provides integral work permits and arc flash calculations in compliance with NFPA 70E Articles 130.1 and 130.3 for all equipment in the facility. The software program used in this study shall comply with the above standards. No substitutions in calculation methods will be allowed.
- B. The arc flash study shall determine the following results for each system mode of operation developed in Section 1.3E (Modeling). The results shall be provided in spreadsheet format for each mode and electrical system location to provide easy viewing and comparison. Worst-case arc flash energy levels shall be flagged and the spreadsheet comparison table shall be capable of providing its output directly to high quality vinyl label printers. The calculations shall, as a minimum, include a comparison of both 100% and 85% arcing currents for low voltage equipment for each electrical system configuration or operating mode, indicating worst-case arc flash hazards. The spreadsheet results shall include:
  1. Equipment name and voltage
  2. Upstream equipment device name and ANSI function, i.e. 51/50, etc.
  3. Equipment type, i.e. switchgear, MCC, Panel, VFD, etc.
  4. Equipment arc gap
  5. Bolted and estimated arcing fault current at the fault point (equipment) in symmetrical amperes. The estimated arcing current should be based on the arcing current equations used.
  6. Trip time, opening time, and total clearing time (total Arc time) of the protective device
  7. Worst-case arc flash boundary for each bus/equipment in the model
  8. Worst-case arc flash hazard incident energy in cal/cm<sup>2</sup> for each bus/equipment in the model

9. Worst-case personal protective equipment (PPE) for each bus/equipment in the model
  10. Working distances for up to five different distances showing items 7, 8, and 9 for each distance
  11. Indicate "Danger/Hazardous" areas where incident energy is greater than 40 cal/cm<sup>2</sup> and provide recommendations to reduced arc flash energy levels for these areas
  12. Flag results where 85% arcing current provided worst-case results
  13. Each mode of operation shall include a detailed write-up indicating areas where incident energy calculations and PPE requirements are higher than calculated in the normal operating mode.
- C. Contractor shall provide a detailed arc flash analysis report including as a minimum:
1. Introduction
  2. Methodology
  3. Information Sources
  4. Assumptions including generic substitutions when data cannot be field verified. This type of assumptions shall be documented in the report.
  5. Arc Flash Energy and other consideration for various System Modes of Operation (maintenance mode, bus-tie, co-gen on/off, etc.)
  6. Arc Energy at 100% and reduced currents
  7. IEEE 1584-2002 Considerations.
  8. Overcurrent Protective Device Changes, Replacements or Setting Changes implemented in study to reduce arc flash hazard exposure.
  9. Explanation of Data in Arc Flash Hazard Report Tables
  10. NFPA 70E Information
    - a. Shock Hazards with covers removed.
    - b. Shock Hazard Approach Boundaries.
      - 1) Limited Approach Boundary
      - 2) Restricted Approach Boundary
      - 3) Prohibited Approach Boundary
    - c. Arc Flash Hazard Boundaries
  11. Results of Arc Flash Hazard Analysis for high voltage, medium voltage and low voltage systems, including:
    - a. Working distances.
    - b. Energy Levels
    - c. PPE Requirements
    - d. Recommendations to reduce arc flash hazard energy and exposure.
  12. Arc Flash Hazard Report
  13. 3 Hard Copies
    - a. 1 Electronic Copy in WORD or Excel format and PDF (5.0 or later)
    - b. 1 Electronic copy in latest version of SKM format or its native software
  14. Electronic file for Power System Modeling Software as developed and utilized for this analysis.
- D. Contractor shall provide print labels for all equipment in the system from the project study file. Assume two (2) labels per equipment/bus in your estimate using 4" x 6" labels. The labels shall be UV resistant vinyl labels (white with orange warning strip and black letters) conforming to ANSI-Z 535. The labels shall be printable directly from the power system software utilized for the study.
- E. The software shall provide complete integration of the one-line, database, short circuit and PDC and Arc flash functions. Software using separate short circuit, PDC, TCC or arc flash programs is not allowed. Spreadsheet calculations are not allowed. The purpose of this section is to ensure that the arc flash hazard calculations comply with NFPA-70E and IEEE-1584, and that the calculations are programmed with necessary requirements to help eliminate possible errors in the arc flash calculations. The additional purpose is to establish a detailed software model of

the compliance with the OSHA requirements and NFPA 70E mandates. This model will serve as an integral part of SMSD safety program by providing integral work permits and arc flash calculations in compliance with NFPA-70E Article 130.1(A)(2) for each electrical equipment in the facility.

1. Arc flash calculations shall be performed with enhanced IEEE-1584 equations, which eliminate voltage discontinuities and the non-conservative/average results of the standard equations. The purpose of this requirement is to ensure that the calculated incident energies are closer to actual test results insuring a conservative calculation minimizing personnel risk.
2. Arc flash calculations shall be based on the fastest clearing upstream protective device protecting the equipment for single sources and the slowest upstream protective device for multiple sources. The calculations shall automatically compare all series and parallel upstream protective devices in the system to determine the fastest series device or a conservative parallel clearing time.
3. The arc flash calculations shall include arc flash boundary, incident energy, PPE requirements, and working distances.
4. The arc flash calculations shall include calculations for all operating modes to ensure the worse arc flash magnitude.
5. The arc flash calculations shall provide integral "Work Tasks" for the listed equipment types. The tasks shall be derived from 70E Table 130.7(C)(9)(a) and be specific to the equipment type. Listed equipment types shall include:
  - a. Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 100-200 volt equipment.
  - b. Switchgear, Switchboards, Panelboards, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 200-1000 volt equipment.
  - c. Switchgear, MCC, VFD, UPS, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 1.0-5.0 kV equipment.
  - d. Switchgear, MCC, VFD, ATS, Interrupting Switch, NEMA E2 Contactor, Conductor, Open Air for 5.0-15.0 kV equipment.
  - e. Interrupting Switch, Conductor, and Open Air for 138 kV equipment.
6. Work Tasks shall have a user-defined library that provides the following customizable features for each work task:
  - a. Work Tasks for each specific equipment type and voltage range
  - b. Working distance units English or Metric
  - c. Work distance for each task
  - d. V-rated gloves and tool requirements
  - e. Job description and procedures
  - f. Safe work practices description
  - g. Hazard Risk Category (HRC) reduction - HRC reduction can only be used based on a documented risk assessment as an integral part of a safety program.

**END OF SECTION 26 05 73**

**26 09 23**

**LIGHTING CONTROL DEVICES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Follow and comply with the SMSD MEP Electrical Standards.

**1.2 SUMMARY**

- A. This Section includes the following lighting control devices:
  - 1. Time switches.
  - 2. Photoelectric switches.
  - 3. Indoor occupancy sensors.
  - 4. Lighting contactors.
  - 5. Emergency shunt relays.
- B. Related Sections include the following:
  - 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

**1.3 DEFINITIONS**

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.
  - 1. Interconnection diagrams showing field-installed wiring.
  - 2. Provide Settings requirements available from the Owner standpoint.
  - 3. Provide the software that will support the lighting controllers.
  - 4. Software must have the ability to detect outages or no power to a branch circuit and graphic indicators.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals.

## **1.5 QUALITY ASSURANCE**

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

## **1.6 COORDINATION**

- A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression system, and partition assemblies.

## **PART 2 - PRODUCTS**

### **2.1 TIME SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Intermatic, Inc.
  - 2. Leviton Mfg. Company Inc.
  - 3. Lightolier Controls; a Genlyte Company.
  - 4. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 5. Watt Stopper (The).
- B. Electronic Time Switches: Electronic, solid-state programmable units with alphanumeric display; complying with UL 917.
- C. Electromechanical-Dial Time Switches: Type complying with UL 917.

### **2.2 OUTDOOR PHOTOELECTRIC SWITCHES**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Intermatic, Inc.
  - 2. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 3. Novitas, Inc.
  - 4. TORK.
  - 5. Watt Stopper (The).

### **2.3 INDOOR OCCUPANCY SENSORS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hubbell Lighting.
  - 2. Leviton Mfg. Company Inc.
  - 3. Lithonia Lighting; Acuity Lighting Group, Inc.
  - 4. Watt Stopper (The).
- B. General Description: Wall- or ceiling-mounting, solid-state units with a separate relay unit.
  - 1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  - 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.

3. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  4. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outlet box.
    - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
  6. Bypass Switch: Override the on function in case of sensor failure.
  7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; keep lighting off when selected lighting level is present.
- C. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
  2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
  3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.

## 2.4 OUTDOOR MOTION SENSORS (PIR)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
1. Bryant Electric; a Hubbell Company.
  2. Hubbell Lighting.
  3. Lithonia Lighting; Acuity Lighting Group, Inc.
  4. Watt Stopper (The).
- C. Performance Requirements: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as rain-tight according to UL 773A.
1. Operation: Turn lights on when sensing infrared energy changes between background and moving body in area of coverage; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
  2. Mounting:
    - a. Sensor: Suitable for mounting in any position on a standard outdoor junction box.
    - b. Relay: Internally mounted in a standard weatherproof electrical enclosure.
    - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
  3. Bypass Switch: Override the on function in case of sensor failure.
  4. Automatic Light-Level Sensor: Adjustable from 1 to 20 fc; keep lighting off during daylight hours.
- D. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.

- E. Lighting Fixture Mounted Sensor: Suitable for switching 300 W of tungsten load at 120- or 277-V ac.
- F. Individually Mounted Sensor: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit.
  - 1. Relay Unit: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
  - 2. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.

## 2.5 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D
  - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
  - 3. Eaton Electrical Inc.; Cutler-Hammer Products.
  - 4. GE.
  - 5. TORK.
- B. Description: Electrically operated and mechanically held, combination type with non-fusible switch complying with NEMA ICS 2 and UL 508.
  - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
  - 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
  - 3. Enclosure: Comply with NEMA 250.
  - 4. Provide with control and pilot devices matching the NEMA type specified for the enclosure.
- C. BAS Interface: Provide hardware interface to enable the BAS to monitor and control lighting contactors.
  - 1. Monitoring: On-off status.
  - 2. Control: On-off operation.

## 2.6 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- C. Class 1 Control Cable: Multi-conductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

### **PART 3 - EXECUTION**

#### **3.1 SENSOR INSTALLATION**

- A. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

#### **3.2 CONTACTOR INSTALLATION**

- A. Mount electrically held lighting contactors with elastomeric isolator pads, to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

#### **3.3 WIRING INSTALLATION**

- A. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and non-power limited conductors according to conductor manufacturer's written instructions.
- C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- E. All conductors shall be installed in an enclosed by a metal raceway.

#### **3.4 IDENTIFICATION**

- A. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
  - 1. Identify controlled circuits in lighting contactors.
  - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

#### **3.5 FIELD QUALITY CONTROL**

- A. Perform the following field tests and inspections and prepare test reports:
  - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
  - 2. Operational Test: Verify operation of each lighting control device and adjust time delays.
- B. Lighting control devices that fail tests and inspections are defective work.

#### **3.6 ADJUSTING**

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

**3.7 DEMONSTRATION**

- A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control system specified in Division 26 Section "Network Lighting Controls."
- B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices. Refer to Division 01 Section "Demonstration and Training."

**END OF SECTION 26 09 23**

**26 11 00**

**FIRE STOPPING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Requirements of Division 16 "COMMON WORK RESULTS FOR ELECTRICAL" apply to this Section.

**1.2 SECTION INCLUDES**

- A. Fireproof fire stopping materials.

**1.3 SUBMITTALS: SUBMIT THE FOLLOWING IN ACCORDANCE WITH SECTION 260500.**

- A. Fireproof fire stopping materials.
- B. Provide U.L. category and file numbers of products.

**1.4 QUALITY ASSURANCE: COMPLY WITH THE FOLLOWING.**

- A. ASTM E814 (UL 1479) - Test Method of Fire Tests of Through-Penetration Fire stops.
- B. NEC 300-21 and NEC 800-52(b).
- C. Conform to applicable code for fire resistance ratings and surface burning characteristics.
- D. Provide certificate of compliance from authority having jurisdiction indicating approval of combustibility.

**1.5 SEQUENCING**

- A. Sequence work to permit fire stopping materials to be installed after adjacent and surrounding work is complete.

**PART 2 - PRODUCTS**

**2.1 MANUFACTURERS**

- A. Flame-Safe FS500, FST600, FS900, FST900, or FSP1000.
- B. Dow Corning 306548 Silicone RTV Foam.
- C. 3M Fire Barrier Penetration Sealing Systems.
- D. PENSIL 851, General Electric Company.

## **2.2 PERFORMANCE REQUIREMENTS**

- A. The requirements of this section shall be provided in addition to the requirements of Division 7.
- B. Maintain required classification, fire, acoustic, and vapor barrier ratings for electrical installations penetrating walls, ceilings, and floors per ASTM E814 (UL 1479), NEC 300-21 and NEC 800-52(b).
  - 1. Penetrations of classified area walls, ceiling and floors shall be sealed with the same material to maintain the integrity of area classification.
  - 2. Penetrations of fire-rated walls, ceilings, and floors shall be sealed with a UL listed Through-Penetrations Fire-Stop System.
  - 3. Penetrations of non-fire-rated walls, ceilings, and floors shall be filled and finished using the same finish material as the wall, ceiling, or floor.
  - 4. Outlet box and lighting fixture installation in fire-rated walls, ceilings, and floors shall be in accordance with the UL Fire Resistance Directory.
- C. Fire safety system shall not require de-rating the ampacity of electrical conductors.
- D. Where mastic is used to seal the surface of the fire stop, the mastic shall be non-hardening.
- E. Fire safety material shall not contract to allow transmission of smoke or water prior to exposure of a fire condition.

## **PART 3 - EXECUTION**

### **3.1 EXAMINATION**

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

### **3.2 PREPARATION**

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter which may affect bond of fire stopping material.
- B. Remove incompatible materials which affect bond.

### **3.3 APPLICATION**

- A. Apply primer and materials in accordance with manufacturer's instructions.
- B. Apply fire stopping material in sufficient thickness to achieve rating to uniform density and texture.
- C. Install material at walls or partition openings which contain penetrating sleeves, piping, ductwork, conduit, and other items requiring fire stopping.
- D. Sleeves shall be of suitable length to accommodate fire stopping system used. Where conduit passes through a sleeve, the clearance around the conduit shall not be less than 1/2".

### **3.4 CLEANING**

- A. Clean adjacent surfaces of fire stopping materials.

**3.5 PROTECTION OF FINISHED WORK**

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

**END OF SECTION 26 11 00**

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**26 24 16**

**PANELBOARDS**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section. Comply and follow with the SMSD – MEP Electrical Standards

**1.2 SUMMARY**

- A. Section Includes:
  - 1. Distribution panelboards.
  - 2. Lighting and appliance branch-circuit panelboards.

**1.3 DEFINITIONS**

- A. SVR: Suppressed voltage rating.
- A. SPD: Surge protective device (suppressor).

**1.4 SUBMITTALS**

- A. Product Data: For each type of panelboard, switching and over-current protective device, surge suppression Protective device (SPD), accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- A. Coordination Drawings: Provide coordination drawings as described in 26 05 00 paragraph 1.03(C).
- B. Shop Drawings: For each panelboard and related equipment.
  - 1. Include dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings.
  - 2. Detail enclosure types and details for types other than NEMA 250, Type 1.
  - 3. Detail bus configuration, current, and voltage ratings.
  - 4. Short-circuit current rating of panelboards and over-current protective devices.
  - 5. Include evidence of NRTL listing for series rating of installed devices.
  - 6. Detail features, characteristics, ratings, and factory settings of individual over-current protective devices and auxiliary components.
  - 7. Include wiring diagrams for power, signal, and control wiring.
  - 8. Include time-current coordination curves for each type and rating of over-current protective device included in panelboards. Submit on translucent log-log graft paper; include selectable ranges for each type of over-current protective device.
  - 9. Fault current rating, brazing and bus rating
- C. Qualification Data: For qualified testing agency.

- D. Field Quality-Control Reports:
  - 1. Test procedures used.
  - 2. Test results that comply with requirements.
  - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- E. Panelboard Schedules: For installation in panelboards.
- F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
  - 1. Manufacturer's written instructions for testing and adjusting over-current protective devices.
  - 2. Time-current curves, including selectable ranges for each type of over-current protective device that allows adjustments.

### 1.5 QUALITY ASSURANCE

- B. Source Limitations: Obtain panelboards, over-current protective devices, components, and accessories from single source from single manufacturer.
- A. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA PB 1.
- D. Comply with NFPA 70.

### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- A. Handle and prepare panelboards for installation according to NEMA PB 1.

### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations:
  - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
  - 1. Ambient temperatures within limits specified.
  - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Owner no fewer than two weeks days in advance of proposed interruption of electric service.
2. Comply with NFPA 70E.

### **1.8 COORDINATION**

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

### **1.9 WARRANTY**

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace transient voltage suppression devices that fail in materials or workmanship within specified warranty period.
  1. Warranty Period: Five years from date of Substantial Completion.

### **1.10 EXTRA MATERIALS**

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Keys: Two spares for each type of panelboard cabinet lock. All keys shall be turn-in to SMSD Owner.
  2. Circuit Breakers Including GFCI and Ground Fault Equipment Protection (GFEP) Types: Two spares for each panelboard.
  3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
  4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

## **PART 2 - PRODUCTS**

### **2.1 GENERAL REQUIREMENTS FOR PANELBOARDS**

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- B. Enclosures: Flush- and surface-mounted cabinets, as indicated on Drawings:
  1. Rated for environmental conditions at installed location.
    - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
    - b. Outdoor Locations: NEMA 250, Type 3R.
    - c. Wash-Down Areas: NEMA 250, Type 4X stainless steel.
    - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
    - e. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Non-corrosive Liquids: NEMA 250, Type 5.
  2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
  3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover.

4. Door in door Hinges: For ease of access to branch circuit wiring.
  5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
  6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
  7. Finishes:
  8. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pre-treating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
    - a. Back Boxes: Same finish as panels and trim.
  9. Directory Card: Inside panelboard door, mounted in metal frame with transparent protective cover.
- C. Incoming Mains Location: Top and bottom.
- D. Phase, Neutral, and Ground Buses:
1. Material: Hard-drawn Copper, 98 percent conductivity.
  2. Coating: Electroplated with Tin to a minimum thickness of 30 micron.
  3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
  4. Isolated Ground Bus: Adequate for branch-circuit isolated ground conductors; insulated from box.
  5. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and UL listed as suitable for nonlinear loads.
  6. Split Bus: Vertical buses divided into individual vertical sections.
- E. Conductor Connectors: Suitable for use with conductor material and sizes.
1. Material: Hard-drawn copper, 98 percent conductivity.
  2. Main and Neutral Lugs: Mechanical type.
  3. Ground Lugs and Bus-Configured Terminators: Mechanical type.
  4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
  5. Sub-feed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  6. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
  7. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- F. Service Equipment Label: NRTL labeled for use as service equipment for panelboards or load centers with one or more main service disconnecting and over-current protective devices.
- G. Future Devices: Mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series-connected ratings are not acceptable.

## 2.2 DISTRIBUTION PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Square D / Schneider Electric
  2. Cutler-Hammer / Eaton
  3. General Electric / ABB

- 4. Siemens
- B. Panelboards: NEMA PB 1, power and feeder distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
  - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
- F. Branch Over-current Protective Devices for Circuit-Breaker Frame Sizes Larger than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Over-current Protective Devices: Circuit Breaker.
- H. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
  - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.

### **2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS**

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Square D / Schneider Electric
  - 2. Cutler-Hammer / Eaton
  - 3. General Electric / ABB
  - 4. Siemens
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Over-current Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, mechanically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
  - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
- F. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.
- G. Column-Type Panelboards: Narrow gutter extension, with cover, to overhead junction box equipped with ground and neutral terminal buses.
- H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Series-connected ratings are not acceptable.

## 2.4 ACCESSORY COMPONENTS AND FEATURES

- A. Accessory Set: Include tools and miscellaneous items required for over-current protective device test, inspection, maintenance, and operation.
- B. Portable Test Set: For testing functions of solid-state trip devices without removing from panelboard. Include relay and meter test plugs suitable for testing panelboard meters and switchboard class relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- B. Examine panelboards before installation. Reject panelboards that are damaged or rusted or have been subjected to water saturation.
- C. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Equipment Mounting: Install panelboards on concrete bases, 4-inch nominal thickness.
  - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around full perimeter of base.
  - 2. For panelboards, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
  - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
  - 4. Install anchor bolts to elevations required for proper attachment to panelboards.
  - 5. Attach panelboard to the vertical finished or structural surface behind the panelboard.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- D. Comply with mounting and anchoring requirements specified in Division 26 Section "Vibration and Seismic Controls for Electrical Systems."
- E. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- F. Mount panelboard cabinet plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box. Mount surface panelboards on 1-5/8 x 1-5/8 Unistrut not on wall surface.
- G. Install over-current protective devices and controllers not already factory installed.
  - 1. Set field-adjustable, circuit-breaker trip ranges.
- H. Install filler plates in unused spaces.

- I. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade. All empty conduits shall be enclosed or sealed.
- J. All conduits, junction boxes, pull boxes and entering and leaving shall be marked or label with circuit numbers.
- K. Conductors inside the panelboards shall be install neat, order and workmanlike manner. Comply and refer to NEC Article 312.
- L. Comply with NECA 1.

### **3.3 IDENTIFICATION**

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with Division 26 Section "Identification for Electrical Systems."
- A. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable.
- B. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."
- C. Device Nameplates: Label each branch circuit device in distribution panelboards with a nameplate complying with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

### **3.4 FIELD QUALITY CONTROL**

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
  - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
  - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
  - 2. Test continuity of each circuit.
- D. Tests and Inspections:
  - 1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
  - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
  - 3. Perform the following infrared scan tests and inspections and prepare reports:
    - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
    - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.

c. Instruments and Equipment:

- 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- E. Panelboards will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection report, including a certified report that identifies panelboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

### 3.5 ADJUSTING

- A. Adjust moving parts and operable component to function smoothly, and lubricate as recommended by manufacturer.
- A. Set field-adjustable circuit-breaker trip ranges as indicated.
- B. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.
1. Measure as directed during period of normal system loading.
  2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
  3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
  4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

### 3.6 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.
- B. Physically protect panelboards against damage. All field-repairs to be performed by and approved by factory-authorized service representative at no added cost to Owner:
1. Touch-up scratches and removed paint with original factory paint.
  1. Replace dented plates and panels.
  2. Repair or replace damaged or non-functional devices.
  3. Replace scratched, discolored, or otherwise damaged nameplate or device identification labels.

### 3.1 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.
- B. Clean the outside and inside the switchboards free from dust.

**END OF SECTION 26 24 16**

**26 27 26**

**WIRING DEVICES**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

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

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Receptacles, receptacles with integral GFCI, and associated device plates.
  - 2. Twist-locking receptacles.
  - 3. Receptacles with integral surge suppression units.
  - 4. Hospital Grade
  - 5. Wall-box motion sensors.
  - 6. Isolated-ground receptacles.
  - 7. Snap switches and wall-box dimmers.
  - 8. Wall-switch and exterior occupancy sensors.
  - 9. Communications outlets.
  - 10. Pendant cord-connector devices.
  - 11. Cord and plug sets.
  - 12. Floor service outlets, poke-through assemblies, service poles, and multi-outlet assemblies.

**1.3 DEFINITIONS**

- A. EMI: Electromagnetic interference.
- B. GFCI: Ground-fault circuit interrupter.
- C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.
- D. RFI: Radio-frequency interference.
- E. SPD: Surge suppressor protective device.
- F. UTP: Unshielded twisted pair.

**1.4 SUBMITTALS**

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: List of legends and description of materials and process used for pre-marking wall plates.

- C. Samples: One for each type of device and wall plate specified, in each color specified.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing label warnings and instruction manuals that include labeling conditions.

### **1.5 QUALITY ASSURANCE**

- A. Source Limitations: Obtain each type of wiring device and associated wall plate through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and one source.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.

### **1.6 COORDINATION**

- A. Receptacles for Owner-Furnished Equipment: Match plug configuration.
  - 1. Cord and Plug Sets: Match equipment requirements.

### **1.7 EXTRA MATERIALS**

- A. Furnish extra materials described in subparagraphs below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Service/Power Poles: One for every 10, but no less than one.
  - 2. Floor Service Outlet Assemblies: One for every 10 but no less than one.
  - 3. Poke-Through, Fire-Rated Closure Plugs: One for every five floor service outlets installed, but no fewer than two.
  - 4. TVSS Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
  - 1. Pass & Seymour/Legrand
  - 2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
  - 3. Leviton Mfg. Company Inc. (Leviton).

### **2.2 STRAIGHT BLADE RECEPTACLES**

- A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand ; 5381 (single), 5352 (duplex).
    - b. Hubbell; HBL5351 (single), CR5352 (duplex).

- c. Leviton; 5891 (single), 5352 (duplex).
- B. Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 configuration 5-20R, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour; 63H
    - b. Hubbell; HBL8300SG.
    - c. Leviton; 8300-SGG.
  - 2. Description: Labeled to comply with NFPA 70, "Health Care Facilities" Article, "Pediatric Locations" Section.

### **2.3 GFCI RECEPTACLES**

- A. General Description: Straight blade, feed-through type. Comply with NEMA WD 1, NEMA WD 6, UL 498, and UL 943, Class A, and include indicator light that is lighted when device is tripped.
- B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand; 2084.

### **2.4 TWIST-LOCKING RECEPTACLES**

- A. Single Receptacles: Comply with NEMA WD 1, NEMA WD 6 configuration and ratings as indicated on Drawings, and UL 498.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand
    - b. Hubbell
    - c. Leviton
- B. Isolated-Ground, Single Receptacles:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell
    - b. Leviton
    - c. Pass & Seymour/Legrand
  - 2. Description: Comply with NEMA WD 1, NEMA WD 6 configuration L5-20R, and UL 498. Equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

### **2.5 PENDANT CORD-CONNECTOR DEVICES**

- A. Description: Matching, locking-type plug and receptacle body connector; NEMA WD 6 configurations L5-20P and L5-20R, heavy-duty grade.
  - 1. Body: Nylon with screw-open cable-gripping jaws and provision for attaching external cable grip.
  - 2. External Cable Grip: Woven wire-mesh type made of high-strength galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.

### **2.6 CORD AND PLUG SETS**

- A. Description: Match voltage and current ratings and number of conductors to requirements of equipment being connected.
  - 1. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and equipment-rating ampacity plus a minimum of 30 percent.
  - 2. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

## 2.7 SNAP SWITCHES

- A. Comply with NEMA WD 1 and UL 20.
- B. Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand; 20AC1 (single pole), 20AC2 (two pole), 20AC3 (three way), 20AC4 (four way).
    - b. Hubbell; CS1221 (single pole), CS1222 (two pole), CS1223 (three way), CS1224 (four way).
    - c. Leviton; 1221-2 (single pole), 1222-2 (two pole), 1223-2 (three way), 1224-2 (four way).
- C. Pilot Light Switches, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand; PS20AC1-PLR for 120 V.
    - b. Hubbell; HPL1221PL for 120 V and 277 V.
    - c. Leviton; 1221-PLR for 120 V, 1221-7PLR for 277 V.
  - 2. Description: Single pole, with neon-lighted handle, illuminated when switch is "ON."
- D. Key-Operated Switches, 120/277 V, 20 A:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand; PS20AC1-L.
    - b. Hubbell; HBL1221L.
    - c. Leviton; 1221-2L.
  - 2. Description: Single pole, with factory-supplied key in lieu of switch handle.
- E. Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand; 1251.
    - b. Hubbell; HBL1557.
    - c. Leviton; 1257.
- F. Key-Operated, Single-Pole, Double-Throw, Momentary Contact, Center-Off Switches, 120/277 V, 20 A; for use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand; 1251L.
    - b. Hubbell; HBL1557L.
    - c. Leviton; 1257L.

## 2.8 WALL-BOX DIMMERS

- A. Dimmer Switches: By same manufacturer of other devices to match dimming technology of connected light fixtures.
- B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

## 2.9 OCCUPANCY SENSORS

- A. Wall-Switch Sensors:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pass & Seymour/Legrand
    - b. Hubbell
    - c. Leviton
    - d. Watt Stopper
  - 2. Description: Dual technology Passive-infrared type/Ultrasonic, 120/277 V, adjustable time delay up to 30 minutes, 180-degree field of view, with a minimum coverage area of 900 sq. ft.
- B. Long-Range Wall-Switch Sensors:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; ATD1600WRP.
    - b. Leviton; ODW12-MRW.
    - c. Watt Stopper (The); DT-200.
    - d. Pass & Seymour/Legrand
  - 2. Description: Dual technology, with both passive-infrared- and ultrasonic-type sensing, 120/277 V, adjustable time delay up to 30 minutes, 110-degree field of view, and a minimum coverage area of 1200 sq. ft.
- C. Wide-Range Wall-Switch Sensors:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Hubbell; ATP120HBRP.
    - b. Leviton; ODWHB-IRW.
    - c. Pass & Seymour; HS1001.
    - d. Watt Stopper (The); CX-100-3.
  - 2. Description: Passive-infrared type, 120/277 V, adjustable time delay up to 30 minutes, 150-degree field of view, with a minimum coverage area of 1200 sq. ft.
- D. Exterior Occupancy Sensors:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Leviton; PS200-10.
    - b. Watt Stopper (The); EW-100-120.
    - c. Pass & Seymour/Legrand
  - 2. Description: Passive-infrared type, 120/277 V, weatherproof, adjustable time delay up to 15 minutes, 180-degree field of view, and 110-foot detection range. Minimum switch rating: 1000-W incandescent, 500-VA fluorescent.

## 2.10 COMMUNICATIONS OUTLETS

- A. Telephone Outlet:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Cooper; 3560-6.
    - b. Leviton; 40649.

2. Description: Single RJ-45 jack for terminating 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e. Comply with UL 1863.

B. Combination TV and Telephone Outlet:

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Cooper; 3562.
  - b. Leviton; 40595.
2. Description: Single RJ-45 jack for 100-ohm, balanced, four-pair UTP; TIA/EIA-568-B.1; complying with Category 5e; and one Type F coaxial cable connector.

## 2.11 WALL PLATES

- A. Single and combination types to be 302/304 stainless steel.
- B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with type 3R weather-resistant thermoplastic with lockable cover.

## 2.12 FLOOR SERVICE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hubbell Incorporated; System One.
- B. Type: Modular, flush-type, dual-service units suitable for wiring method used.
- C. Compartments: Barrier separates power from voice and data communication cabling.
- D. Service Plate: Rectangular, solid brass, coordinate finish with Architect prior to ordering.
- E. Power Receptacle: NEMA WD 6 configuration 5-20R, gray finish, unless otherwise indicated.
- F. Voice and Data Communication Outlet: Blank cover with bushed cable opening.

## 2.13 POKE-THROUGH ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Hubbell Incorporated; System One.
- B. Description: Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/fire-stop unit and detachable matching floor service outlet assembly.
  1. Service Outlet Assembly: Pedestal type with services indicated.
  2. Size: Selected to fit nominal 3-inch cored holes in floor and matched to floor thickness.
  3. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.
  4. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.
  5. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, 4-pair, Category 5e voice and data communication cables.

## 2.14 MULTIOUTLET ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Hubbell Incorporated; Wiring Device-Kellems.
- B. Components of Assemblies: Products from a single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- C. Raceway Material: Metal, with manufacturer's standard finish.
- D. Wire: Minimum No. 12 AWG.

## **2.15 SERVICE POLES**

- A. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
  - 1. Poles: Nominal 2.5-inch square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
  - 2. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.
  - 3. Finishes: Manufacturer's standard painted finish and trim combination.
  - 4. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, 4-pair, Category 3 or 5 voice and data communication cables.
  - 5. Power Receptacles: Two duplex, 20-A, heavy-duty, NEMA WD 6 configuration 5-20R units.
  - 6. Voice and Data Communication Outlets: Blank insert with bushed cable opening.

## **2.16 FINISHES**

- A. Color: Wiring device catalog numbers in Section Text do not designate device color.
  - 1. Wiring Devices Connected to Normal Power System: Ivory, or as selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
  - 2. Wiring Devices Connected to Emergency Power System: Red.
  - 3. TVSS Devices: Blue.
  - 4. Isolated-Ground Receptacles: Orange.

## **PART 3 - EXECUTION**

### **3.1 INSTALLATION**

- A. Comply with NECA 1, including the mounting heights listed in that standard, unless otherwise noted.
- B. Coordination with Other Trades:
  - 1. Take steps to insure that devices and their boxes are protected. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of the boxes. Cut holes need not to be more than 1/8" inch in all sides of the box.
  - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
  4. Boxes and conduit shall be rigidly supported to the wall. Do not use spacer type supports.
  5. Install wiring devices after all wall preparation, including painting, is complete.
  6. Do not use extension ring in any applications.
- C. Conductors:
1. Do not strip insulation from conductors until just before they are spliced or terminated on devices.
  2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
  3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300.14, without pigtails. Multiple duplex receptacles shall be use pigtail and use the screw terminals to terminate the wire not the back of the receptacle outlet.
  4. Conductors shall be identified with circuit number at the box.
  5. Existing Conductors:
    - Cut back and pigtail or replace all damaged conductors.
    - a. Straighten conductors that remain and remove corrosion and foreign matter.
    - b. Pigtailling existing conductors is permitted provided the outlet box is large enough.
- D. Device Installation:
1. Replace all devices that have been in temporary use during construction or that show signs that they were installed before building finishing operations were complete.
  2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
  3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
  4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
  5. Use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, 2/3 to 3/4 of the way around terminal screw.
  6. Use a torque screwdriver when a torque is recommended or required by the manufacturer.
  7. When conductors larger than No. 12 AWG are installed on 20-A circuits, splice No. 12 AWG pigtails for device connections.
  8. Tighten unused terminal screws on the device.
  9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device mounting screws in yokes, allowing metal-to-metal contact.
- E. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
  2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.
- F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.
- G. Dimmers:
1. Install dimmers within terms of their listing.
  2. Verify that dimmers used for fan speed control are listed for that application.
  3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

### **3.2 IDENTIFICATION**

- A. Comply with Division 26 Section "Identification for Electrical Systems."
  - 1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.
  - 2. Receptacles: Label or marked the cover with panel and circuit number back and front cover.

### **3.3 FIELD QUALITY CONTROL**

- A. Perform tests and inspections and prepare test reports.
  - 1. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.
  - 2. Test Instruments: Use instruments that comply with UL 1436.
  - 3. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated LED indicators of measurement.
- B. Tests for Convenience Receptacles:
  - 1. Line Voltage: Acceptable range is 105 to 132 V.
  - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is not acceptable.
  - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
  - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
  - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
  - 6. The tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

**END OF SECTION 26 27 26**

**26 51 00**

**INTERIOR LIGHTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
- B. Follow and comply with the SMSD MEP Electrical Standards.

**1.2 SUMMARY**

- A. This Section includes the following:
  - 1. Interior lighting fixtures and drivers.
  - 2. Emergency lighting units.
  - 3. Exit signs LED lighted
  - 4. Lighting fixture supports.
- B. Related Sections include the following:
  - 1. Division 26 Section "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multiple lighting relays and contactors.
  - 2. Division 26 Section "Wiring Devices" for manual wall-box dimmers for incandescent lamps.
  - 3. Division 26 Section "Theatrical Lighting" for theatrical lighting fixtures and their controls.
- C. Submittals:
  - 1. Provide cut-sheets and summary all types of fixtures for review.

**1.3 DEFINITIONS**

- A. BF: Ballast factor.
- B. CRI: Color-rendering index.
- C. CU: Coefficient of utilization.
- D. LER: Luminaire efficacy rating.
- E. Luminaire: Complete lighting fixture, including ballast housing if provided.
- F. RCR: Room cavity ratio.
- G. LED Light Emitted Diode

#### 1.4 SUBMITTALS

- A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
  - 1. Physical description of lighting fixture including dimensions.
  - 2. Emergency lighting units including battery and charger.
  - 3. Ballast.
  - 4. Energy-efficiency data.
  - 5. Air and Thermal Performance Data: For air-handling lighting fixtures. Furnish data required in "Submittals" Article in Division 23 Section "Diffusers, Registers, and Grilles."
  - 6. Sound Performance Data: For air-handling lighting fixtures. Indicate sound power level and sound transmission class in test reports certified according to standards specified in Division 23 Section "Diffusers, Registers, and Grilles."
  - 7. Life, output, and energy-efficiency data for lamps.
  - 8. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
    - a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.
    - b. Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program (NVLAP) for Energy Efficient Lighting Products.
- B. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.
  - 1. Wiring Diagrams: Power and control wiring.
- C. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
  - 1. Lamps: Specified units installed.
  - 2. Accessories: Cords and plugs.
- D. Product Certificates: For each type of ballast for bi-level and dimmer-controlled fixtures, signed by product manufacturer.
- E. Qualification Data: For agencies providing photometric data for lighting fixtures.
- F. Field quality-control test reports.
- G. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.
- H. Warranties: Special warranties specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.
- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NFPA 70.
- D. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.
- E. Mockups: Provide interior lighting fixtures for room or module mock-ups, complete with power and control connections.
  - 1. Obtain Architect's approval of fixtures for mockups before starting installations.
  - 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
  - 3. Approved fixtures in mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## **1.6 COORDINATION**

- A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

## **1.7 WARRANTY**

- A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Emergency Lighting Unit Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining nine years.
  - 2. Warranty Period for Emergency Fluorescent Ballast Batteries: 5 years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining six years.
- B. Special Warranty for Ballasts: Manufacturer's standard form in which ballast manufacturer agrees to repair or replace ballasts that fail in materials or workmanship within specified warranty period.
  - 1. Warranty Period for Electronic Ballasts: Five years from date of Substantial Completion.
  - 2. Warranty Period for Electromagnetic Ballasts: Three years from date of Substantial Completion.
- C. Special Warranty for T5 and T8 Fluorescent Lamps: Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
  - 1. Warranty Period: Two (2) year(s) from date of Substantial Completion.

## **1.8 EXTRA MATERIALS**

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Plastic Diffusers and Lenses: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
3. Battery and Charger Data: One for each emergency lighting unit.
4. Ballasts: 1 for every 100 of each type and rating installed. Furnish at least one of each type.
5. Globes and Guards: 1 for every 20 of each type and rating installed. Furnish at least one of each type.

## **PART 2 - PRODUCTS**

### **2.1 MANUFACTURERS**

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
- B. In Interior Lighting Fixture Schedule where titles below are column or row headings that introduce lists, the following requirements apply to product selection:
  1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
- C. Luminaires, Acceptable Manufacturers:
  1. Cooper
  2. Genlyte
  3. General Electric
  4. Hubbell
  5. Kenall
  6. Lithonia
- D. Lamps, Acceptable Manufacturers:
  1. General Electric
  2. Osram Sylvania
  3. North American Phillips
- E. Ballasts, Acceptable Manufacturers:
  1. Advance Transformer Co.
  2. Universal Lighting Technology
  3. Osram
  4. Sylvania

### **2.2 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS**

- A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.
- A. Incandescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5A.
- B. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.
- C. Metal Parts: Free of burrs and sharp corners and edges.
- D. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

- E. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit re-lamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during re-lamping and when secured in operating position.
- F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
  - 1. White Surfaces: 85 percent.
  - 2. Specular Surfaces: 83 percent.
  - 3. Diffusing Specular Surfaces: 75 percent.
  - 4. Laminated Silver Metalized Film: 90 percent.
- G. Plastic Diffusers, Covers, and Globes:
  - 1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
    - a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
    - b. UV stabilized.
  - 2. Glass: Annealed crystal glass, unless otherwise indicated.
- H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagnetic-interference as required by MIL-STD-461E. Fabricate lighting fixtures, indicated to require a filter, with one filter per ballast.
- I. Air-Handling Fluorescent Fixtures: For use with plenum ceiling for air return and heat extraction and for attaching an air-diffuser-boot assembly specified in Division 23 Section "Diffusers, Registers, and Grilles."
  - 1. Air Supply Units: Slots in one or both side trims join with air-diffuser-boot assemblies.
  - 2. Heat Removal Units: Air path leads through lamp cavity.
  - 3. Combination Heat Removal and Air Supply Unit: Heat is removed through lamp cavity at both ends of the fixture door with air supply same as for air supply units.
  - 4. Dampers: Operable from outside fixture for control of return-air volume.
  - 5. Static Fixture: Air supply slots are blanked off, and fixture appearance matches active units.

### **2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS**

- A. Electronic Ballasts: Comply with ANSI C82.11; instant-start type, unless otherwise indicated, and designed for type and quantity of lamps served. Ballasts shall be designed for full light output unless dimmer or bi-level control is indicated.
  - 1. Sound Rating: A.
  - 2. Total Harmonic Distortion Rating: Less than 10 percent.
  - 3. Transient Voltage Protection: IEEE C62.41, Category A or better.
  - 4. Operating Frequency: 20 kHz or higher.
  - 5. Lamp Current Crest Factor: 1.7 or less.
  - 6. BF: 0.88 or higher.
  - 7. Power Factor: 0.95 or higher.
  - 8. Parallel Lamp Circuits: Multiple lamp ballasts shall comply with ANSI C 82.11 and shall be connected to maintain full light output on surviving lamps if one or more lamps fail.
- B. Electronic Programmed-Start Ballasts for T5 Lamps: Comply with ANSI C82.11 and the following:
  - 1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
  - 2. Automatic lamp starting after lamp replacement.
  - 3. Sound Rating: A.
  - 4. Total Harmonic Distortion Rating: Less than 20 percent.

5. Transient Voltage Protection: IEEE C62.41, Category A or better.
  6. Operating Frequency: 20 kHz or higher.
  7. Lamp Current Crest Factor: 1.7 or less.
  8. BF: 0.95 or higher, unless otherwise indicated.
  9. Power Factor: 0.95 or higher.
- C. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.
1. Ballast Manufacturer Certification: Indicated by label.
- D. Ballasts for Low-Temperature Environments:
1. Temperatures 0 Deg F and Higher: Electronic or electromagnetic type rated for 0 deg F starting and operating temperature with indicated lamp types.
- E. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.
- F. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
  2. Ballast Input Watts: Can be reduced to 20 percent of normal.
  3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
- G. Ballasts for Bi-Level Controlled Lighting Fixtures: Electronic type.
1. Operating Modes: Ballast circuit and leads provide for remote control of the light output of the associated lamp between high- and low-level and off.
    - a. High-Level Operation: 100 percent of rated lamp lumens.
    - b. Low-Level Operation: 30 percent of rated lamp lumens.
  2. Ballast shall provide equal current to each lamp in each operating mode.
  3. Compatibility: Certified by manufacturer for use with specific bi-level control system and lamp type indicated.

## 2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

- A. Description: Electronic programmed rapid-start type, complying with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated:
1. Lamp end-of-life detection and shutdown circuit.
  2. Automatic lamp starting after lamp replacement.
  3. Sound Rating: A.
  4. Total Harmonic Distortion Rating: Less than 20 percent.
  5. Transient Voltage Protection: IEEE C62.41, Category A or better.
  6. Operating Frequency: 20 kHz or higher.
  7. Lamp Current Crest Factor: 1.7 or less.
  8. BF: 0.95 or higher, unless otherwise indicated.
  9. Power Factor: 0.95 or higher.
  10. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
  11. Ballast Case Temperature: 75 deg C, maximum.
- B. Ballasts for Dimmer-Controlled Lighting Fixtures: Electronic type.
1. Dimming Range: 100 to 5 percent of rated lamp lumens.
  2. Ballast Input Watts: Can be reduced to 20 percent of normal.

3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.

## 2.5 EMERGENCY FLUORESCENT POWER UNIT

- A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within lighting fixture body and compatible with ballast. Comply with UL 924.
  1. Emergency Connection: Operate 1 fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect un-switched circuit to battery-inverter unit and switched circuit to fixture ballast.
  2. Night-Light Connection: Operate one fluorescent lamp continuously.
  3. Test Push Button and Indicator Light: Visible and accessible without opening fixture or entering ceiling space.
    - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  4. Battery: Sealed, maintenance-free, nickel-cadmium type.
  5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
  6. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  7. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

## 2.6 BALLASTS FOR HID LAMPS

- A. Electromagnetic Ballast for Metal-Halide Lamps: Comply with ANSI C82.4 and UL 1029. Include the following features, unless otherwise indicated:
  1. Ballast Circuit: Constant-wattage autotransformer or regulating high-power-factor type.
  2. Minimum Starting Temperature: Minus 22 deg F for single-lamp ballasts.
  3. Normal Ambient Operating Temperature: 104 deg F.
  4. Open-circuit operation that will not reduce average life.
  5. Low-Noise Ballasts: Manufacturers' standard epoxy-encapsulated models designed to minimize audible fixture noise.
- B. Electronic Ballast for Metal-Halide Lamps: Include the following features unless otherwise indicated:
  1. Lamp end-of-life detection and shutdown circuit.
  2. Sound Rating: A.
  3. Total Harmonic Distortion Rating: Less than 15 percent.
  4. Transient Voltage Protection: IEEE C62.41, Category A or better.
  5. Lamp Current Crest Factor: 1.5 or less.
  6. Power Factor: .90 or higher.
  7. Interference: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for non-consumer equipment.
  8. Protection: Class P thermal cutout.
  9. Retain subparagraph and associated subparagraphs below for bi-level ballasts.
  10. Bi-Level Dimming Ballast: Ballast circuit and leads provide for remote control of the light output of the associated fixture between high- and low-level and off.
    - a. High-Level Operation: 100 percent of rated lamp lumens.
    - b. Low-Level Operation: 35 percent of rated lamp lumens.

- c. Compatibility: Certified by ballast manufacturer for use with specific bi-level control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
- 11. Continuous Dimming Ballast: Dimming range shall be from 100 to 35 percent of rated lamp lumens without flicker.
  - a. Ballast Input Watts: Reduced to a maximum of 50 percent of normal at lowest dimming setting.
  - b. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated. Certified by lamp manufacturer that ballast operating modes are free from negative effect on lamp life and color-rendering capability.
- C. Auxiliary Instant-On Quartz System: Factory-installed feature automatically switches quartz lamp on when fixture is initially energized and when power outages occur. System automatically turns quartz lamp off when HID lamp reaches approximately 60 percent light output.
- D. High-Pressure Sodium Ballasts: Electromagnetic type, with solid-state igniter/starter. Igniter-starter shall have an average life in pulsing mode of 10,000 hours at an igniter/starter-case temperature of 90 deg C.
  - 1. Instant Re-strike Device: Integral with ballast, or solid-state potted module, factory installed within fixture and compatible with lamps, ballasts, and mogul sockets up to 150 W.
    - a. Re-strike Range: 105- to 130-V ac.
    - b. Maximum Voltage: 250-V peak or 150-V ac RMS.
  - 2. Minimum Starting Temperature: Minus 40 deg F.
  - 3. Open-circuit operation shall not reduce average lamp life.

## 2.7 EXIT SIGNS LED LIGHTED

- A. Description: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
  - 1. Lamps for AC Operation: Fluorescent, 2 for each fixture, 20,000 hours of rated lamp life.
  - 2. Lamps for AC Operation: LEDs, 70,000 hours minimum rated lamp life.
  - 3. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.
    - a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    - b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    - c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    - d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    - e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
    - f. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

- g. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.
- 4. Master/Remote Sign Configurations:
  - a. Master Unit: Comply with requirements above for self-powered exit signs, and provide additional capacity in LED power supply for power connection to remote unit.
  - b. Remote Unit: Comply with requirements above for self-powered exit signs, except omit power supply, battery and test features. Arrange to receive full power requirements from master unit. Connect for testing concurrently with master unit as a unified system.

## 2.8 EMERGENCY LIGHTING UNITS

- A. Description: Self-contained units complying with UL 924.
  - 1. Battery: Sealed, maintenance-free, lead-acid type.
  - 2. Charger: Fully automatic, solid-state type with sealed transfer relay.
  - 3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
  - 4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
  - 5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
  - 6. Wire Guard: Heavy-chrome-plated wire guard protects lamp heads or fixtures.
  - 7. Integral Time-Delay Relay: Holds unit on for fixed interval of 5 minutes when power is restored after an outage.
  - 8. Remote Test: Switch in hand-held remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
  - 9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and flashing red LED.

## 2.9 LIGHTING FIXTURE SUPPORT COMPONENTS

- A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel-and angle-iron supports and nonmetallic channel and angle supports.
- A. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
- B. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.
- C. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.
- E. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

- F. Hook Hangers: Integrated assembly matched to fixture and line voltage and equipped with threaded attachment, cord, and locking-type plug.

### **PART 3 - EXECUTION**

#### **3.1 INSTALLATION**

- A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.
- B. Support for Lighting Fixtures in or on Grid-Type Suspended Ceilings: Use grid as a support element.
  - 1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from lighting fixture corners.
  - 2. Support Clips: Fasten to lighting fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.
  - 3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.
  - 4. Install at least ~~one~~ FOUR independent support rod or wire from BUILDING structure to a tab on lighting fixture. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.
- C. Suspended Lighting Fixture Support:
  - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
  - 2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
  - 3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
- D. Air-Handling Lighting Fixtures: Install with dampers closed and ready for adjustment.
- E. Adjust aim-able lighting fixtures to provide required light intensities.
- F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

#### **3.2 FIELD QUALITY CONTROL**

- A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.
- A. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

#### **3.3 CLEANING**

- A. Clean the diffuser or lenses before installing to the fixture.

**END OF SECTION 26 51 00**

**26 95 00**

**FIELD ELECTRICAL TESTING**

**PART 1 - GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Requirements of Division 26 "COMMON WORK RESULTS FOR ELECTRICAL" apply to this Section.

**1.2 SECTION INCLUDES**

- A. Testing by Installing Contractor
- B. Testing by Independent Certified Testing Contractor
- C. All testing shall be witness with the Owner, Commissioning Agent, Engineer or Architect.

**1.3 SUBMITTALS: SUBMIT THE FOLLOWING IN ACCORDANCE WITH SECTION 260500.**

- A. Contractor shall submit experience and certified of testing firm and individuals who will be performing and evaluating tests before any tests are done.
- B. Contractor shall submit in writing at least 24 hours in advance notification of the occurrence of any test described in this section.
- C. Contractor shall record all test data and submit three (3) copies for review. In addition to the test data, each record shall include; date of test, ambient temperature, climate conditions, instruments used, names of test personnel and witnesses and identification of items tested.
- D. The testing firm shall maintain a written record of all tests and, upon completion of project, shall assemble and certify a final test report.

**1.4 QUALITY ASSURANCE: COMPLY WITH THE FOLLOWING.**

- A. All tests shall be done in accordance with all applicable codes and standards.
- B. Qualifications of Testing Firm:
  - 1. The testing firm shall be an independent testing organization which can function as an unbiased testing authority, professionally independent of the manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.
  - 2. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.
  - 3. The testing firm shall meet OSHA criteria for accreditation of testing laboratories, Title 29, or be a Full Member company of the International Electrical Testing Association (IETA).
  - 4. The testing firm shall utilize engineers and technicians who are regularly employed by the firm for testing services.

## **PART 2 - PRODUCTS (NOT USED)**

## **PART 3 - EXECUTION**

### **3.1 DIVISION OF RESPONSIBILITY**

- A. All tests indicate in this specification section shall be done by the testing firm except the installing contractor shall be responsible for the following:
1. The contractor shall perform routine insulation-resistance, continuity, and rotation tests for all distribution and utilization equipment prior to and in addition to tests performed by the testing firm specified herein.
  2. 120 Volt General Purpose Receptacles: All 120 volt general purpose receptacles shall be tested for correct connection using a Hubbell Catalog #5200 or equal receptacle tester.
  3. 120 Volt Ground Fault Circuit, Interrupter (GFCI) Receptacles: All 120 volt GFCI receptacles shall be tested for correct connection and rating using Hubbell Catalog #GFT-2G with a range of 2 to 7 milliamps.
  4. Enclosed (Disconnect) Switches: Subsequently to completion of installation of electrical disconnect switches, energize circuits and demonstrate capability and compliance with requirements. Except as otherwise indicated, do not test switches by operating them under load. However, demonstrate switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure for inspection of interior, mechanical and electrical connections, fuse installation, and for verification of type and rating of fuses installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.
  5. Light Switching: Verify proper connection and operation of switches for lighting fixtures.
  6. Lighting Contactors: Demonstrate proper operation of lighting contactors for all items indicated in Division 16.
  7. Balancing Loads: After Substantial Completion, but not more than two months after Final Acceptance, conduct load-balancing measurements on panelboards and circuit changes as follows:
    - a. Perform measurements during period of normal working load as advised by the Owner.
    - b. Perform load-balancing circuit changes outside the normal occupancy/working schedule of the facility. Make special arrangements with Owner to avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
    - c. Recheck loads after circuit changes during normal load period. Record all load readings before and after changes and submit test records.
    - d. Tolerance: Difference between phase loads exceeding 20 percent at any one panelboard is not acceptable. Rebalance and recheck as required to meet this minimum requirement.
- B. The Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the specific power requirements.
- C. The Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
- D. Any system, material, or workmanship which is found defective on the basis of acceptance tests shall be reported to the Owner/Engineer's representative replaced or repaired by the Contractor at no cost to the Owner, and retested.
- E. An electrical system will not be accepted until tested in its entirety and results reported to the Owner.

### **3.2 TESTING FIRM**

- A. The testing firm shall test the following equipment as indicated in each section:
  - 1. 600V Wire and Cables
  - 2. Grounding and Bonding.
  - 3. Dry Type Transformers.
  - 4. Enclosed Motor Controllers
  - 5. Motor Control Center
  - 6. Panelboards
  - 7. Switchboards/Switchgear

### **3.3 INFRARED BASELINE SCANNING**

- A. Provide scanning for Switchboards, Transformers, MCC's, Panelboards, Generator connection points, Copper Busses, Circuit Breakers, Terminations and Transfer Switches.
- B. After Substantial Completion, but not more than two (2) months after Final Acceptance, perform an infrared IR scan in Section 26-95-00 Part 3, 3.2 of each panelboard, switchboard and pad mounted transformer. Remove fronts to make joints and connections accessible to a portable scanner.
- C. Instrument: Use an approved infrared IR scanning device designed to measure temperature or detect significant deviations from normal values. Provide calibration record for device used.
- D. Record of Infrared IR Scanning: Prepare a certified report identifying panelboards checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

**END OF SECTION 26 95 00**