

INDIAN HILLS MIDDLE SCHOOL

1180 East Sanders Road, Sandy, UT, 84094

Canyons School District

*Project Manual*

Specifications

Construction Documents

21 MARCH 2025

FFKR ARCHITECTS

## TABLE OF CONTENTS

### DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS

### DIVISION 01 - GENERAL REQUIREMENTS

SECTION 01 0000	GENERAL REQUIREMENTS
SECTION 01 1000	SUMMARY
SECTION 01 2500	SUBSTITUTION PROCEDURES
SECTION 01 2600	CONTRACT MODIFICATION PROCEDURES
SECTION 01 2900	PAYMENT PROCEDURES
SECTION 01 3100	PROJECT MANAGEMENT AND COORDINATION
SECTION 01 3200	CONSTRUCTION PROGRESS DOCUMENTATION
SECTION 01 3233	PHOTOGRAPHIC DOCUMENTATION
SECTION 01 3300	SUBMITTAL PROCEDURES
SECTION 01 4000	QUALITY REQUIREMENTS
SECTION 01 5000	TEMPORARY FACILITIES AND CONTROLS
SECTION 01 6000	PRODUCT REQUIREMENTS
SECTION 01 7300	EXECUTION
SECTION 01 7700	CLOSEOUT PROCEDURES
SECTION 01 7823	OPERATION AND MAINTENANCE DATA
SECTION 01 7839	PROJECT RECORD DOCUMENTS
SECTION 01 7900	DEMONSTRATION AND TRAINING
SECTION 01 9113	GENERAL COMMISSIONING REQUIREMENTS
DIVISION 02 – EXISTING CONDITIONS	
SECTION 02 4118	SELECTIVE STRUCTURE DEMOLITION

### DIVISION 03 – CONCRETE

SECTION 03 3000	CAST-IN-PLACE CONCRETE
-----------------	------------------------

### DIVISION 04 – MASONRY

SECTION 04 2113	BRICK MASONRY
-----------------	---------------

### DIVISION 05 – METALS

SECTION 05 1200	STRUCTURAL STEEL FRAMING
SECTION 05 5213	PIPE AND TUBE RAILINGS

### DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

SECTION 06 1053	MISCELLANEOUS ROUGH CARPENTRY
SECTION 06 4116	PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

### DIVISION 07 – THERMAL AND MOISTURE PROTECTION

SECTION 07 2100	THERMAL INSULATION
SECTION 07 8100	APPLIED FIREPROOFING
SECTION 07 8413	THROUGH-PENETRATION FIRESTOP SYSTEMS
SECTION 07 9200	JOINT SEALANTS

DIVISION 08 – OPENINGS

SECTION 08 1113	HOLLOW METAL DOORS AND FRAMES
SECTION 08 1416	FLUSH WOOD DOORS
SECTION 08 7100	DOOR HARDWARE

DIVISION 09 – FINISHES

SECTION 09 2216	NON-STRUCTURAL METAL FRAMING
SECTION 09 2900	GYPSUM BOARD
SECTION 09 3000	TILING
SECTION 09 5113	ACOUSTICAL PANEL CEILINGS
SECTION 09 6513	RESILIENT BASE AND ACCESSORIES
SECTION 09 6519	RESILIENT TILE FLOORING
SECTION 09 6543	LINOLEUM FLOORING
SECTION 09 6813	TILE CARPETING
SECTION 09 6816	SHEET CARPETING
SECTION 09 8400	GEOMETRIC UNIFORM DIFFUSER
SECTION 09 8400	QUADRATIC RESIDUE DIFFUSER
SECTION 09 8400	SOUND REDIRECTOR
SECTION 09 8433	SOUND-ABSORPTING WALL UNITS
SECTION 09 9123	INTERIOR PAINTING

DIVISION 10 – SPECIALTIES

SECTION 10 1100	VISUAL DISPLAY SURFACES
SECTION 10 1423	SIGNAGE

DIVISION 12 – FURNISHINGS

SECTION 12 3623	PLASTIC-LAMINATE-CLAD COUNTERTOPS
-----------------	-----------------------------------

DIVISION 21 – FIRE SUPPRESSION

SECTION 21 1000	WATER-BASED FIRE-SUPPRESSION SYSTEMS
-----------------	--------------------------------------

DIVISION 22 - PLUMBING

SECTION 22 0500	COMMON WORK RESULTS FOR PLUMBING
SECTION 22 0518	ESCUTCHEONS FOR PLUMBING PIPING
SECTION 22 0523	GENERAL-DUTY VALVES FOR PLUMBING PIPING
SECTION 22 0529	HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
SECTION 22 0719	PLUMBING PIPING INSULATION
SECTION 22 1116	DOMESTIC WATER PIPING
SECTION 22 1119	DOMESTIC WATER PIPING SPECIALTIES
SECTION 22 1316	SANITARY WASTE AND VENT PIPING

SECTION 22 1319	SANITARY WASTE PIPING SPECIALTIES
SECTION 22 4000	PLUMBING FIXTURES

DIVISION 23 - HEATING VENTILATING AND AIR CONDITIONING

SECTION 23 0100	MECHANICAL REQUIREMENTS
SECTION 23 0500	COMMON WORK RESULTS FOR HVAC
SECTION 23 0519	METERS AND GAGES FOR HVAC
SECTION 23 0529	HANGERS AND SUPPORTS
SECTION 23 0548	SEISMIC RESTRAINT AND VIBRATION ISOLATION
SECTION 23 0553	IDENTIFICATION FOR HVAC PIPING & EQUIPMENT
SECTION 23 0593	TESTING ADJUSTING AND BALANCING FOR HVAC
SECTION 23 0700	DUCT INSULATION
SECTION 23 0719	HVAC PIPE INSULATION
SECTION 23 0900	HVAC INSTRUMENTATION AND CONTROLS
SECTION 23 2113	HYDRONIC PIPING
SECTION 23 2116	HYDRONIC PIPING SPECIALTIES
SECTION 23 3001	COMMON DUCT REQUIREMENTS
SECTION 23 3113	METAL DUCTS
SECTION 23 3300	AIR DUCT ACCESSORIES
SECTION 23 3600	AIR TERMINAL UNITS
SECTION 23 3713	DIFFUSERS, REGISTERS, AND GRILLES

DIVISION 26 – ELECTRICAL

SECTION 26 0500	ELECTRICAL GENERAL PROVISIONS
SECTION 26 0502	ELECTRICAL SUBMITTALS & O&M MANUALS
SECTION 26 0507	ELECTRICAL CONNECTIONS FOR EQUIPMENT
SECTION 26 0519	CONDUCTORS & CABLES (600V & BELOW)
SECTION 26 0526	GROUNDING
SECTION 26 0529	SUPPORTING DEVICES
SECTION 26 0532	CONDUIT RACEWAY
SECTION 26 0533	ELECTRICAL BOXES AND FITTINGS
SECTION 26 0553	ELECTRICAL IDENTIFICATION
SECTION 26 0943	LIGHTING CONTROL EQUIPMENT
SECTION 26 2726	WIRING DEVICES
SECTION 26 2815	OVERCURRENT PROTECTIVE DEVICES
SECTION 26 4119	DEMOLITION
SECTION 26 5100	INTERIOR AND EXTERIOR BUILDING LIGHTING

DIVISION 27 – COMMUNICATIONS

SECTION 27 1500	NETWORK CABLING GLOBAL SPECIFICATION
SECTION 27 4100	AUDIOVISUAL SYSTEM
SECTION 27 4101	AUDIOVISUAL SYSTEM CHECKLISTS
SECTION 27 5123	SOUND & INTERCOMMUNICATION SYSTEMS.

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

SECTION 28 3111	FIRE ALARM AND DETECTION SYSTEM
-----------------	---------------------------------



## SUPPLEMENTARY INSTRUCTIONS TO BIDDERS

### 1.1 INSTRUCTIONS TO BIDDERS

- A. Instructions to Bidders for Project consist of the following:
  - 1. AIA Document A701, "Instructions to Bidders," a copy of which is bound in this Project Manual.
  - 2. The following Supplementary Instructions to Bidders that modify and add to the requirements of the Instructions to Bidders.

### 1.2 SUPPLEMENTARY INSTRUCTIONS TO BIDDERS, GENERAL

- A. The following supplements modify AIA Document A701, "Instructions to Bidders." Where a portion of the Instructions to Bidders is modified or deleted by these Supplementary Instructions to Bidders, unaltered portions of the Instructions to Bidders shall remain in effect.

### 1.3 ARTICLE 2 - BIDDER'S REPRESENTATIONS

- A. Add Section 2.1.3.1:
  - 1. 2.1.3.1 - The Bidder has investigated all required fees, permits, and regulatory requirements of authorities having jurisdiction and has properly included in the submitted bid the cost of such fees, permits, and requirements not otherwise indicated as provided by Owner.
- B. Add Section 2.1.5:
  - 1. 2.1.5 - The Bidder is a properly licensed Contractor according to the laws and regulations of the State of Utah and meets qualifications indicated in the Procurement and Contracting Documents.
- C. Add Section 2.1.6:
  - 1. 2.1.6 - The Bidder has incorporated into the Bid adequate sums for work performed by installers whose qualifications meet those indicated in the Procurement and Contracting Documents.

### 1.4 ARTICLE 3 - BIDDING DOCUMENTS

- A. 3.4 - Addenda:
  - 1. Delete Section 3.4.3 and replace with the following:

- a. 3.4.3 - Addenda may be issued at any time prior to the receipt of bids.
  - 2. Add Section 3.4.4.1:
    - a. 3.4.4.1 - Owner may elect to waive the requirement for acknowledging receipt of 3.4.4 Addenda as follows:
      - 1) 3.4.4.1.1 - Information received as part of the Bid indicates that the Bid, as submitted, reflects modifications to the Procurement and Contracting Documents included in an unacknowledged Addendum.
      - 2) 3.4.4.1.2 - Modifications to the Procurement and Contracting Documents in an unacknowledged Addendum do not, in the opinion of Owner, affect the Contract Sum or Contract Time.
- 1.5 ARTICLE 4 - BIDDING PROCEDURES
- A. 4.1 - Preparation of Bids:
    - 1. Add Section 4.1.1.1:
      - a. 4.1.1.1 - Printable electronic Bid Forms and related documents are available from Construction Manager.
    - 2. Add Section 4.1.9:
      - a. 4.1.9 - Owner may elect to disqualify a bid due to failure to submit a bid in the form requested, failure to bid requested alternates or unit prices, failure to complete entries in all blanks in the Bid Form, or inclusion by the Bidder of any alternates, conditions, limitations or provisions not called for.
  - B. 4.3 - Submission of Bids:
    - 1. Add Section 4.3.1.2:
      - a. 4.3.1.2 - Include Bidder's Contractor License Number applicable in Project jurisdiction on the face of bid form.
- 1.6 ARTICLE 5 - CONSIDERATION OF BIDS
- A. 5.2 - Rejection of Bids:
    - 1. Add Section 5.2.1:
      - a. 5.2.1 - Owner reserves the right to reject a bid based on Owner's and Architect's evaluation of qualification information submitted following opening of bids. Owner's evaluation of the Bidder's qualifications will include: status of licensure and record of compliance with licensing requirements, record of quality of

completed work, record of Project completion and ability to complete, record of financial management including financial resources available to complete Project and record of timely payment of obligations, record of Project site management including compliance with requirements of authorities having jurisdiction, record of and number of current claims and disputes and the status of their resolution, and qualifications of the Bidder's proposed Project staff and proposed subcontractors.

1.7 ARTICLE 6 - POSTBID INFORMATION

A. 6.3 - Submittals:

1. Add Section 6.3.1.4:

- a. 6.3.1.4 - Submit information requested in Sections 6.3.1.1, 6.3.1.2, and 6.3.1.3 no later than two business days following Construction Manager's request.

1.8 ARTICLE 7 - PERFORMANCE BOND AND PAYMENT BOND

A. 7.1 - Bond Requirements:

1. Add Section 7.1.1.1:

- a. 7.1.1.1 - Both a Performance Bond and a Payment Bond will be required, each in an amount equal to 100 percent of the Contract Sum.

B. 7.2 - Time of Delivery and Form of Bonds:

1. Delete the first sentence of Section 7.2.1 and insert the following:

- a. The Bidder shall deliver the required bonds to Owner no later than 10 days after the date of Notice of Intent to Award and no later than the date of execution of the Contract, whichever occurs first. Owner may deem the failure of the Bidder to deliver required bonds within the period of time allowed a default.

2. Delete Section 7.2.3 and insert the following:

- a. 7.2.3 - Bonds shall be executed and be in force on the date of the execution of the Contract.

1.9 ARTICLE 9 - EXECUTION OF THE CONTRACT

A. Add Article 9:

- 1. 9.1.1 - Subsequent to the Notice of Intent to Award, and within 10 days after the prescribed Form of Agreement is presented to the Awardee for signature, the Awardee

- shall execute and deliver the Agreement to Owner through Architect, in such number of counterparts as Owner may require.
2. 9.1.2 - Owner may deem as a default the failure of the Awardee to execute the Contract and to supply the required bonds when the Agreement is presented for signature within the period of time allowed.
  3. 9.1.3 - Unless otherwise indicated in the Procurement and Contracting Documents or the executed Agreement, the date of commencement of the Work shall be the date of the executed Agreement or the date that the Bidder is obligated to deliver the executed Agreement and required bonds to Owner.
  4. 9.1.4 - In the event of a default, Owner may declare the amount of the Bid security forfeited and elect to either award the Contract to the next responsible bidder or re-advertise for bids.

END OF DOCUMENT

## SECTION 01 0000 – GENERAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes general requirements that are to apply to all Work throughout the Project. Requirements included in this Section are to apply to all other specification Sections.

#### 1.3 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved" or "Conforms": When used to convey Architect's action on Contractor's submittals, applications, and requests, "approved" or "conforms" is limited to Architect's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Center of...": Indicates a specific single point at the exact center of the tile, panel, or other surface indicated.
- D. "Contractor or CM/GC.": The Construction Manager/General Contractor (CMGC) as indicated in General Conditions document, unless otherwise stated.
- E. "Directed": A command or instruction by Architect, unless indicated as by Owner. Other terms including "requested," "authorized," "selected," "approved," "required," and "permitted" have the same meaning as "directed."
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- H. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- I. "Project Manager": The Contractor's project manager.
- J. "Project Representative": The Owner's project representative(s).

- K. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.
- L. "Provide": Furnish and install, complete and ready for the intended use.
- M. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- N. "Related Sections": Related Sections articles are included herein as a courtesy to assist in the locating of items in the specifications that the reader might expect to find in the Section but that are specified elsewhere. The list of sections may or may not be complete. 'Related Sections' articles do not relieve the Contractor of the contractual obligation to perform to all the Contract Documents or to coordinate who does what amongst the team of subcontractors.

#### 1.4 SITE INSPECTION

- A. Examine the premises and site and compare them with the drawings and specifications.
- B. Become familiar with existing conditions such as obstructive areas, excavating or filling, and any problems related to construction. No allowances will subsequently be made by reason of failure to examine the site.

#### 1.5 SCOPE OF THE WORK

- A. See Division 1 Section 01 1000 "Summary" for an overall general summary of the Work.
- B. Unless otherwise provided, all materials, labor, equipment, tools, transportation, and utilities necessary for the successful completion of the Project shall be provided at the expense of the Contractor.
- C. Requirements of the Work are contained in the Contract Documents, and include cross-references herein to published information, which is not necessarily bound therewith.
- D. Provide, as part of the Bid and without additional charge, all incidental items required for completion of the Work, even if not specifically indicated.
  - 1. Install all Work so that its several component parts function together as a complete and workable system, and with all equipment properly adjusted and in working order.
- E. Conform to highest quality standards for materials and workmanship to execute Work that is indicated or specified and that is necessary to fully satisfy the Contract Document requirements for a complete, finished, acceptable installation regardless of whether indicated or specified or not.
- F. Responsibilities of the Contractor includes the responsibility to verify all field measurements of actual building conditions so that all Work fits properly in the locations indicated and specified.

Protect existing structures, improvements, trees, and other items from physical damage, unless identified to be removed.

- G. Any existing surfaces, furniture or equipment that are damaged by the Contractor are to be restored to their original condition, or better, to the satisfaction of the Owner.
- H. Restore roads, utilities, walks, curbs, gutters or other improvements belonging to the Owner, to the same condition as they existed prior to commencement of construction. Where said improvements are damaged, they shall be replaced by new Work to match existing adjacent Work, or repaired if acceptable to Project Representative, at no cost to Owner.

#### 1.6 WORKERS

- A. Enforce strict discipline and good order among his/her employees at all times and shall not employ on the Project any unfit person or anyone not skilled in the Work assigned to him/her.
- B. Consumption of alcohol or any other controlled, non-medically prescribed substance will not be allowed on the Project.
- C. Rectify behavior unacceptable to the Owner or Owner's Project Representative by strict enforcement of discipline. Owner reserves the right to request dismissal of individual workers for failure to comply with standards of behavior communicated to the Contractor.

#### 1.7 TAXES

- A. The Contractor shall pay sales, use, payroll, unemployment, old age pension, or surtax applicable to this project.
- B. The Owner shall pay taxes and assessments on real property comprising the site of this project.

#### 1.8 MANUFACTURER'S DIRECTIONS

- A. Manufactured articles, materials, or equipment shall be applied, installed, connected, erected, used, cleaned, and conditioned in accordance with the Manufacturer's printed directions unless otherwise indicated in the Contract Documents.

#### 1.9 FASTENERS

- A. Unless noted otherwise, the trade requiring the fastening of its Work to any substrate or support is responsible for provision and installation of requisite fasteners.

#### 1.10 PENETRATIONS

- A. The sealing of all penetrations in fire-rated, acoustically-rated or structural partitions and separations is the responsibility of the trade making or requiring the penetration.

INDIAN HILLS MIDDLE SCHOOL  
1180 East Sanders Road, Sandy, UT 84094  
Canyons School District

100% Construction Documents

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 0000



## SECTION 01 1000 - SUMMARY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Project information.
  - 2. Work covered by Contract Documents.
  - 3. Work by Owner.
  - 4. Owner-furnished products.
  - 5. Access to site.
  - 6. Work restrictions.

- B. Related Requirements:

- 1. Section 01 5000 "Temporary Facilities and Controls" for limitations and procedures governing temporary use of Owner's facilities.

#### 1.3 PROJECT INFORMATION

- A. Project Identification: Indian Hills Middle School.

- 1. Project Location: 1180 East Sanders Road, Sandy Ut. 84094.

- B. Owner: Canyons School District.

- 1. Owner's Representative: Carl Patterson, 801-826-5133.

- C. Architect: FFKR Architects, 730 Pacific Avenue, Salt Lake City, Utah 84104, (801) 521-6186.

- 1. Project Manager: Lynn Attwood, AIA, FFKR Architects 801-517-4344

- D. Architect's Consultants: The Architect has retained the following design professionals who have prepared designated portions of the Contract Documents:

- 1. Structural Engineer: Henning Ungerman, Calder Richards Consulting 801-466-1699.
  - 2. Mechanical Engineer: Brian Druce, Van Boerum & Frank Associates, Inc. 801-530-3148
  - 3. Electrical Engineer: Drayton Bailey, BNA Consulting 801-532-2196
  - 4. Civil Engineer: Gregory Nelson, CRS Engineers 801-359-5565

5. Food Services: Jedrzewski Designs, Ric Jedrzewski 801-403-9073
6. Landscape Architect: Abram Nielsen, FFKR Architects 801-517-4359.
7. Geotechnical Engineer: Jay McQuivey, AGECE 801-566-6399.

E. Other Owner Consultants:

1. Geotechnical Engineer: Applied Geotech, David Nordquist 801-566-6399

F. A Construction Manager/General Contractor (CM/GC) has been engaged as Contractor for this Project.

1. CM/GC: Cris Hogan, Hogan & Associates Construction, Inc. 801-951-7000.
  - a. Primary Contact: Dennis Forbush.

G. Project Web Site: A project Web site (Newforma) administered by Architect will be used for purposes of managing communication and documents during the construction stage.

1. See Section 01 3100 "Project Management and Coordination" for requirements for using the Project Web site.

#### 1.4 WORK COVERED BY CONTRACT DOCUMENTS

A. The Work of Project is defined by the Contract Documents and consists of the following:

1. The Work of Project as defined by the Contract Documents, includes interior remodeling of an existing school building, additions as indicated, replacement of an existing roof, and miscellaneous landscaping.
  - a. Work may include other Work as indicated in Section 01 2300 "Alternates".

B. Type of Contract:

1. Project will be constructed under a single prime contract.

#### 1.5 OWNER-FURNISHED PRODUCTS

A. Owner will furnish products indicated. The Work includes receiving, unloading, handling, storing, protecting, and installing Owner-furnished products.

B. Owner-Furnished Products:

1. Toilet accessories to extent not indicated in Section 10 2800 "Toilet and Bath Accessories."
2. Projectors. (Contractor to install.)
3. Appliances, furnishings, sewing machines, and equipment not specified herein.

1.6 ACCESS TO SITE

- A. General: 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.
- B. Use of Site: Limit use of Project site to areas within the Contract limits indicated. Do not disturb portions of Project site beyond areas in which the Work is indicated.
  - 1. Driveways, Walkways and Entrances: Keep driveways loading areas, 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.
    - a. Schedule deliveries to minimize use of driveways and entrances by construction operations.
    - b. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.
- C. Condition of Existing Building: Maintain portions of existing building affected by construction operations in a weathertight condition throughout construction period. Repair damage caused by construction operations.

1.7 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.
  - 1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.
- B. Controlled Substances: Use of tobacco products and other controlled substances on Project site is not permitted.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 1000

## SECTION 01 2500 - SUBSTITUTION PROCEDURES

### 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 substitutions.
- B. Related Requirements:
  - 1. Section 01 6000 "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.

#### 1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

#### 1.4 ACTION SUBMITTALS

- A. Substitution Requests: 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.
  - 1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
    - a. Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.
    - b. Coordination information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors, that will be necessary to accommodate proposed substitution.
    - c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work specified.
    - d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.

- e. Samples, where applicable or requested.
  - f. Certificates and qualification data, where applicable or requested.
  - g. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.
  - h. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
  - i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
  - j. 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 date of receipt of purchase order, lack of availability, or delays in delivery.
  - k. Bids proposing substitution of specified roofing system will be considered only if bid submittals are complete and include all components and details of proposed roofing system. Submittals for substitute roof membrane system must include, but is not limited to, any additional protection membranes, flashing materials, fasteners, adhesives, and other products required to provide a complete and weatherproof roofing system equivalent in performance to the system specified and providing an equivalent warranty.
  - l. Cost information, including a proposal of change, if any, in the Contract Sum.
  - m. Contractor's certification that proposed substitution complies with requirements in the Contract Documents except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.
  - n. 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.
2. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days 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 seven days of receipt of additional information or documentation, whichever is later.
- a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
  - b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

## 1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

## 1.6 PROCEDURES

- A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

## PART 2 - PRODUCTS

### 2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution at time of bid.
  - 1. 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:
    - a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
    - b. Substitution request is fully documented and properly submitted.
    - c. Requested substitution will not adversely affect Contractor's construction schedule.
    - d. Requested substitution has received necessary approvals of authorities having jurisdiction.
    - e. Requested substitution is compatible with other portions of the Work.
    - f. Requested substitution has been coordinated with other portions of the Work.
    - g. Requested substitution provides specified warranty.
    - h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.
- B. Substitutions for Convenience: Not allowed.

## PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2500

## SECTION 01 2600 - CONTRACT MODIFICATION PROCEDURES

### 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 handling and processing Contract modifications.
- B. Related Requirements:
  - 1. Section 01 2500 "Substitution Procedures" for administrative procedures for handling requests for substitutions made after the Contract award.

#### 1.3 MINOR CHANGES IN THE WORK

- A. Architect will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

#### 1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
  - 1. Work Change Proposal Requests issued by Architect are not instructions either to stop work in progress or to execute the proposed change.
  - 2. Within time specified in Proposal Request or 20 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
    - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
    - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
    - c. Include costs of labor and supervision directly attributable to the change.
    - d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and

finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

- e. Quotation Form: Use forms acceptable to Architect.

- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Architect.

1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
4. Include costs of labor and supervision directly attributable to the change.
5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
7. Proposal Request Form: Use form acceptable to Architect.

## 1.5 ADMINISTRATIVE CHANGE ORDERS

- A. Allowance Adjustment: See Section 01 2100 "Allowances" for administrative procedures for preparation of Change Order Proposal for adjusting the Contract Sum to reflect actual costs of allowances.

## 1.6 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Work Changes Proposal Request, Architect will issue a Change Order for signatures of Owner and Contractor on AIA Document G701.

## 1.7 CONSTRUCTION CHANGE DIRECTIVE

- A. Construction Change Directive: Architect may issue a Construction Change Directive on AIA Document G714. Construction Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
  1. Construction Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.



- B. Documentation: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.
  - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600

## SECTION 01 2900 - PAYMENT PROCEDURES

### 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 necessary to prepare and process Applications for Payment.
- B. Related Requirements:
  - 1. Section 01 2600 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
  - 2. Section 01 3200 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.

#### 1.3 DEFINITIONS

- A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

#### 1.4 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule.
  - 1. Coordinate line items in the schedule of values with other required administrative forms and schedules, including the following:
    - a. Application for Payment forms with continuation sheets.
    - b. Submittal schedule.
    - c. Items required to be indicated as separate activities in Contractor's construction schedule.
  - 2. Submit the schedule of values to Architect at earliest possible date, but no later than seven days before the date scheduled for submittal of initial Applications for Payment.
- B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the schedule of values:
  - a. Project name and location.
  - b. Name of Architect.
  - c. Architect's project number.
  - d. Contractor's name and address.
  - e. Date of submittal.
2. Arrange schedule of values consistent with format of AIA Document G703.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with Project Manual table of contents. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
  - a. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
  - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.
6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
  - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place may be shown either as separate line items in the schedule of values or distributed as general overhead expense, at Contractor's option.
8. Schedule Updating: Update and resubmit the schedule of values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

#### 1.5 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments as certified by Architect and paid for by Owner.
  1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.

- B. Payment Application Times: The date for each progress payment is indicated in the Agreement between Owner and Contractor. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.
- C. Application for Payment Forms: Use AIA Document G702/CMA and AIA Document G703 as form for Applications for Payment.
- D. Application for Payment Forms: Use forms acceptable to Architect and Owner for Applications for Payment. Submit forms for approval with initial submittal of schedule of values.
- E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Architect will return incomplete applications without action.
  - 1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
  - 2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
  - 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
  - 4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.
- F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site.
  - 1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
  - 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
  - 3. Provide summary documentation for stored materials indicating the following:
    - a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
    - b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
    - c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.
- G. Transmittal: Submit three signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
  - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

- H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
  2. When an application shows completion of an item, submit conditional final or full waivers.
  3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
  4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.
- I. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
1. List of subcontractors.
  2. Schedule of values.
  3. Contractor's construction schedule (preliminary if not final).
  4. Products list (preliminary if not final).
  5. Submittal schedule (preliminary if not final).
  6. List of Contractor's staff assignments.
  7. List of Contractor's principal consultants.
  8. Copies of building permits.
  9. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
  10. Initial progress report.
  11. Report of preconstruction conference.
  12. Certificates of insurance and insurance policies.
  13. Performance and payment bonds.
  14. Data needed to acquire Owner's insurance.
- J. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
  2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
- K. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
  2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
  3. Updated final statement, accounting for final changes to the Contract Sum.
  4. AIA Document G706, "Contractor's Affidavit of Payment of Debts and Claims."
  5. AIA Document G706A, "Contractor's Affidavit of Release of Liens."

6. AIA Document G707, "Consent of Surety to Final Payment."
7. Evidence that claims have been settled.
8. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
9. Final liquidated damages settlement statement.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900

## SECTION 01 3100 - PROJECT MANAGEMENT AND COORDINATION

### 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 provisions for coordinating construction operations on Project including, but not limited to, the following:
  - 1. General coordination procedures.
  - 2. Coordination drawings.
  - 3. Requests for Information (RFIs).
  - 4. Project Web site.
  - 5. Project meetings.
- B. Related Requirements:
  - 1. Section 01 3200 "Construction Progress Documentation" for preparing and submitting Contractor's construction schedule.
  - 2. Section 01 7300 "Execution" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
  - 3. Section 01 7700 "Closeout Procedures" for coordinating closeout of the Contract.
  - 4. Section 01 9113 "General Commissioning Requirements" for coordinating the Work with Owner's Commissioning Authority.

#### 1.3 DEFINITIONS

- A. RFI: Request from Owner, Architect, or Contractor seeking information required by or clarifications of the Contract Documents.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. 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. 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.

- B. Key Personnel Names: Within 15 days of starting construction operations, submit a list of key personnel 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, office, and cellular telephone numbers and e-mail addresses. Provide names, addresses, and telephone numbers of individuals assigned as alternates 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. Keep list current at all times.

## 1.5 GENERAL COORDINATION PROCEDURES

- A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations, included in different Sections, that 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 to ensure maximum performance and accessibility for required maintenance, service, and repair.
  - 3. Make adequate provisions to accommodate items scheduled for later installation.
- B. 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, the following:
  - 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. Preinstallation conferences.
  - 7. Project closeout activities.
  - 8. Startup and adjustment of systems.



## 1.6 COORDINATION DRAWINGS

- A. Coordination Drawings, General: Prepare coordination drawings according to requirements in individual Sections, and additionally where installation is not completely shown on Shop Drawings, where limited space availability necessitates coordination, or if coordination is required to facilitate integration of products and materials fabricated or installed by more than one entity.
1. Content: Project-specific information, drawn accurately to a scale large enough to indicate and resolve conflicts. Do not base coordination drawings on standard printed data. Include the following information, as applicable:
    - a. Use applicable Drawings as a basis for preparation of coordination drawings. Prepare sections, elevations, and details as needed to describe relationship of various systems and components.
    - b. Indicate functional and spatial relationships of components of architectural, structural, civil, mechanical, and electrical systems.
    - c. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
    - d. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
    - e. Indicate required installation sequences.
    - f. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
- B. Coordination Drawing Organization: Organize coordination drawings as follows:
1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
  2. Plenum Space: Indicate subframing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within ceiling plenum to accommodate layout of light fixtures indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
  3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
  4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
  5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
  6. Mechanical and Plumbing Work: Show the following:
    - a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.

- b. Dimensions of major components, such as dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
  - c. Fire-rated enclosures around ductwork.
- 7. Electrical Work: Show the following:
  - a. Runs of vertical and horizontal conduit 1-1/4 inches in diameter and larger.
  - b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
  - c. Panel board, switch board, switchgear, transformer, busway, generator, and motor control center locations.
  - d. Location of pull boxes and junction boxes, dimensioned from column center lines.
- 8. Fire-Protection System: Show the following:
  - a. Locations of standpipes, mains piping, branch lines, pipe drops, and sprinkler heads.
- 9. Review: Architect will review coordination drawings to confirm that the Work is being coordinated, but not for the details of the coordination, which are Contractor's responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform Contractor, who shall make changes as directed and resubmit.
- 10. Coordination Drawing Prints: Prepare coordination drawing prints according to requirements in Section 01 3300 "Submittal Procedures."

#### 1.7 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.
  - 1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
  - 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
  - 1. Project name.
  - 2. Project number.
  - 3. Date.
  - 4. Name of Contractor.
  - 5. Name of Architect.
  - 6. RFI number, numbered sequentially.
  - 7. RFI subject.
  - 8. Specification Section number and title and related paragraphs, as appropriate.
  - 9. Drawing number and detail references, as appropriate.
  - 10. Field dimensions and conditions, as appropriate.

11. Contractor's suggested resolution. If Contractor's suggested resolution impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
  12. Contractor's signature.
  13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
    - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: AIA Document G716 or Software-generated form with substantially the same content as indicated above, acceptable to Architect.
1. Attachments shall be electronic files in Adobe Acrobat PDF format.
- D. Architect's Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect's response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.
1. The following Contractor-generated RFIs will be returned without action:
    - a. Requests for approval of submittals.
    - b. Requests for approval of substitutions.
    - c. Requests for approval of Contractor's means and methods.
    - d. Requests for coordination information already indicated in the Contract Documents.
    - e. Requests for adjustments in the Contract Time or the Contract Sum.
    - f. Requests for interpretation of Architect's actions on submittals.
    - g. Incomplete RFIs or inaccurately prepared RFIs.
  2. Architect's action may include a request for additional information, in which case Architect's time for response will date from time of receipt of additional information.
  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.
- E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Submit log weekly. Include the following:
1. Project name.
  2. Name and address of Contractor.
  3. Name and address of Architect.
  4. RFI number including RFIs that were returned without action or withdrawn.
  5. RFI description.
  6. Date the RFI was submitted.
  7. Date Architect's response was received.

- 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 seven days if Contractor disagrees with response.
  - 1. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

#### 1.8 PROJECT WEB SITE

- A. Use Architect's Project Web site for purposes of hosting and managing the following project communication and documentation until Final Completion. Architect's Project Web site includes the following functions:
  - 1. Project directory.
  - 2. RFI forms.
  - 3. Task and issue management.
  - 4. Submittals forms and logs.
  - 5. Drawing and specification document hosting, viewing, and updating.
  - 6. Online document collaboration.
  - 7. Reminder and tracking functions.
  - 8. Archiving functions.
- B. Architect will issue drawings and Specifications through the Project Website.
- C. Architect will accept and return RFIs and submittal documents only through the Project Website, unless otherwise arranged.

#### 1.9 PROJECT MEETINGS

- A. General: Schedule and conduct meetings and conferences 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.
  - 2. Agenda: Prepare the meeting agenda. Distribute the agenda to all invited attendees.
  - 3. Minutes: Entity responsible for conducting meeting will record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three days of the meeting.
- B. Preconstruction Conference: Schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Architect, but no later than 15 days after execution of the Agreement.
  - 1. Conduct the conference to review responsibilities and personnel assignments.
  - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the

conference shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect progress, including the following:

- a. Tentative construction schedule.
- b. Phasing.
- c. Critical work sequencing and long-lead items.
- d. Designation of key personnel and their duties.
- e. Lines of communications.
- f. Procedures for processing field decisions and Change Orders.
- g. Procedures for RFIs.
- h. Procedures for testing and inspecting.
- i. Procedures for processing Applications for Payment.
- j. Distribution of the Contract Documents.
- k. Submittal procedures.
- l. Preparation of record documents.
- m. Use of the premises and existing building.
- n. Work restrictions.
- o. Working hours.
- p. Owner's occupancy requirements.
- q. Responsibility for temporary facilities and controls.
- r. Procedures for moisture and mold control.
- s. Procedures for disruptions and shutdowns.
- t. Construction waste management and recycling.
- u. Parking availability.
- v. Office, work, and storage areas.
- w. Equipment deliveries and priorities.
- x. First aid.
- y. Security.
- z. Progress cleaning.

4. Minutes: Entity responsible for conducting meeting will record and distribute meeting minutes.

- 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 and Owner's Commissioning Authority 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 RFIs.
  - d. Related Change Orders.
  - e. Purchases.

- f. Deliveries.
    - g. Submittals.
    - h. Review of mockups.
    - i. Possible conflicts.
    - j. Compatibility requirements.
    - k. Time schedules.
    - l. Weather limitations.
    - m. Manufacturer's written instructions.
    - n. Warranty requirements.
    - o. Compatibility of materials.
    - p. Acceptability of substrates.
    - q. Temporary facilities and controls.
    - r. Space and access limitations.
    - s. Regulations of authorities having jurisdiction.
    - t. Testing and inspecting requirements.
    - u. Installation procedures.
    - v. Coordination with other work.
    - w. Required performance results.
    - x. Protection of adjacent work.
    - y. Protection of construction and personnel.
  - 3. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
  - 4. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
  - 5. 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. Project Closeout Conference: Schedule and conduct a project closeout conference, at a time convenient to Owner and Architect, but no later than 90 days prior to the scheduled date of Substantial Completion.
- 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
  - 2. Attendees: Authorized representatives of Owner, Owner's Commissioning Authority, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
    - a. Preparation of record documents.
    - b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
    - c. Submittal of written warranties.
    - d. Requirements for preparing operations and maintenance data.
    - e. Requirements for delivery of material samples, attic stock, and spare parts.
    - f. Requirements for demonstration and training.

- g. Preparation of Contractor's punch list.
    - h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
    - i. Submittal procedures.
    - j. Owner's partial occupancy requirements.
    - k. Installation of Owner's furniture, fixtures, and equipment.
    - l. Responsibility for removing temporary facilities and controls.
  - 4. Minutes: Entity conducting meeting will record and distribute meeting minutes.
- E. Progress Meetings: Conduct progress meetings at weekly intervals.
- 1. Coordinate dates of meetings with preparation of payment requests.
  - 2. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority 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 meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
  - 3. 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.
      - 1) Review schedule for next period.
    - b. Review present and future needs of each entity present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Progress cleaning.
      - 10) Quality and work standards.
      - 11) Status of correction of deficient items.
      - 12) Field observations.
      - 13) Status of RFIs.
      - 14) Status of proposal requests.
      - 15) Pending changes.
      - 16) Status of Change Orders.
      - 17) Pending claims and disputes.

- 18) Documentation of information for payment requests.
4. Minutes: Entity responsible for conducting the meeting will record and distribute the meeting minutes to each party present and to parties requiring information.
    - 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.
- F. Coordination Meetings: Conduct Project coordination meetings at weekly intervals. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings and preinstallation conferences.
1. Attendees: In addition to representatives of Owner, Owner's Commissioning Authority 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 meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
  2. Agenda: Review and correct or approve minutes of the previous coordination meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to status of Project.
    - a. Combined Contractor's Construction Schedule: Review progress since the last coordination meeting. Determine whether each contract is on time, ahead of schedule, or behind schedule, in relation to combined 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. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
    - c. Review present and future needs of each contractor present, including the following:
      - 1) Interface requirements.
      - 2) Sequence of operations.
      - 3) Status of submittals.
      - 4) Deliveries.
      - 5) Off-site fabrication.
      - 6) Access.
      - 7) Site utilization.
      - 8) Temporary facilities and controls.
      - 9) Work hours.
      - 10) Hazards and risks.
      - 11) Progress cleaning.
      - 12) Quality and work standards.
      - 13) Change Orders.



3. Reporting: Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100

## SECTION 01 3200 - CONSTRUCTION PROGRESS DOCUMENTATION

### 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 documenting the progress of construction during performance of the Work, including the following:
  - 1. Startup construction schedule.
  - 2. Contractor's construction schedule.
  - 3. Construction schedule updating reports.
  - 4. Daily construction reports.
  - 5. Material location reports.
  - 6. Site condition reports.
  - 7. Special reports.
- B. Related Requirements:
  - 1. Section 01 3300 "Submittal Procedures" for submitting schedules and reports.
  - 2. Section 01 4000 "Quality Requirements" for submitting a schedule of tests and inspections.

#### 1.3 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 Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
  - 2. Predecessor Activity: An activity that precedes another activity in the network.
  - 3. Successor Activity: An activity that follows another activity in the network.
- 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 connected chain of interdependent 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 successor activity.
  - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- F. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Format for Submittals: Submit required submittals in the following format:
  - 1. Working electronic copy of schedule file, where indicated.
  - 2. PDF electronic file.
- B. Startup construction schedule.
- C. Startup Network Diagram: Of size required to display entire network for entire construction period. Show logic ties for activities.
- D. Contractor's Construction Schedule: Initial schedule, of size required to display entire schedule for entire construction period.
  - 1. Submit a working electronic copy of schedule, using software indicated, and labeled to comply with requirements for submittals. Include type of schedule (initial or updated) and date on label.
- E. CPM Reports: Concurrent with CPM schedule, submit each of the following reports. Format for each activity in reports shall contain activity number, activity description, cost and resource loading, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in calendar days.
  - 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. Construction Schedule Updating Reports: Submit with Applications for Payment.

- G. Daily Construction Reports: Submit at weekly intervals.
- H. Material Location Reports: Submit at weekly intervals.
- I. Site Condition Reports: Submit at time of discovery of differing conditions.
- J. Special Reports: Submit at time of unusual event.
- K. Qualification Data: For scheduling consultant.

#### 1.5 QUALITY ASSURANCE

- A. Prescheduling Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "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 interim milestones.
  - 4. Review delivery dates for Owner-furnished products.
  - 5. Review schedule for work of Owner's separate contracts.
  - 6. Review submittal requirements and procedures.
  - 7. Review time required for review of submittals and resubmittals.
  - 8. Review requirements for tests and inspections by independent testing and inspecting agencies.
  - 9. Review time required for Project closeout and Owner startup procedures, including commissioning activities.
  - 10. Review and finalize list of construction activities to be included in schedule.
  - 11. Review procedures for updating schedule.

#### 1.6 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, submittal schedule, progress reports, payment requests, and other required schedules and reports.
  - 1. Secure time commitments for performing critical elements of the Work from entities involved.
  - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

## PART 2 - PRODUCTS

### 2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

- A. Time Frame: Extend schedule from date established for commencement of the Work to date of final completion.
  - 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.
- B. Activities: Treat each story or separate area as a separate numbered activity for each main 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 the following 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 Section 01 3300 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's construction schedule with submittal schedule.
  - 4. Startup and Testing Time: Include no fewer than 15 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.
  - 6. Punch List and Final Completion: Include not more than 30 days for completion of punch list items and final completion.
- C. 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. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Section 01 1000 "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
  - 2. 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. Partial occupancy before Substantial Completion.
    - e. Use of premises restrictions.
    - f. Provisions for future construction.
    - g. Seasonal variations.
    - h. Environmental control.
  - 3. 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. Startup and placement into final use and operation.
4. Construction Areas: 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. Temporary enclosure and space conditioning.
  - c. Permanent space enclosure.
  - d. Completion of mechanical installation.
  - e. Completion of electrical installation.
  - f. Substantial Completion.
- D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and final completion.
- E. Cost Correlation: Superimpose a cost correlation timeline, indicating planned and actual costs. On the line, show planned and actual dollar volume of the Work performed as of planned and actual dates used for preparation of payment requests.
  1. See Section 01 2900 "Payment Procedures" for cost reporting and payment procedures.
- F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next schedule update. Summarize the following issues:
  1. Unresolved issues.
  2. Unanswered Requests for Information.
  3. Rejected or unreturned submittals.
  4. Notations on returned submittals.
  5. Pending modifications affecting the Work and Contract Time.
- G. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.
- H. Computer Scheduling Software: Prepare schedules using current version of a program that has been developed specifically to manage construction schedules.

## 2.2 STARTUP CONSTRUCTION SCHEDULE

- A. Bar-Chart Schedule: Submit startup, 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 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

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

- A. General: Prepare network diagrams using AON (activity-on-node) format.
- B. Startup Network Diagram: Submit diagram within 14 days of date established for commencement of the Work. Outline significant construction activities for the first 90 days of construction. Include skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.
- C. CPM Schedule: Prepare Contractor's construction schedule using a time-scaled CPM network analysis diagram for the Work.
  - 1. Develop network diagram in sufficient time to submit CPM schedule so it can be accepted for use no later than 60 days after date established for commencement of the Work.
    - a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of Architect's approval of the schedule.
  - 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 for individual activities. Indicate nonworking days and holidays incorporated into the schedule in order to coordinate with the Contract Time.
- D. CPM Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup 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. Mobilization and demobilization.

- c. Purchase of materials.
  - d. Delivery.
  - e. Fabrication.
  - f. Utility interruptions.
  - g. Installation.
  - h. Work by Owner that may affect or be affected by Contractor's activities.
  - i. Testing and commissioning.
  - j. Punch list and final completion.
  - k. Activities occurring following final completion.
2. Critical Path Activities: Identify critical path activities, including those for interim completion dates. Scheduled start and completion dates shall be consistent with Contract milestone dates.
3. Processing: Process data to produce output data on 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.
4. 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.
- E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis using a network fragment to demonstrate the effect of the proposed change on the overall project schedule.
- F. Initial Issue of Schedule: Prepare initial network diagram from a sorted activity list indicating straight "early start-total float." Identify critical activities. Prepare tabulated reports showing the following:
  1. Contractor or subcontractor and the Work or activity.
  2. Description of activity.
  3. Main 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).
- G. 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.

H. 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.

2.4 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. Equipment at Project site.
5. Material deliveries.
6. High and low temperatures and general weather conditions, including presence of rain or snow.
7. Accidents.
8. Meetings and significant decisions.
9. Unusual events (see special reports).
10. Stoppages, delays, shortages, and losses.
11. Meter readings and similar recordings.
12. Emergency procedures.
13. Orders and requests of authorities having jurisdiction.
14. Change Orders received and implemented.
15. Construction Change Directives received and implemented.
16. Services connected and disconnected.
17. Equipment or system tests and startups.
18. Partial completions and occupancies.
19. Substantial Completions authorized.

B. Material Location Reports: At weekly intervals, prepare and submit 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. Indicate the following categories for stored materials:

1. Material stored prior to previous report and remaining in storage.
  2. Material stored prior to previous report and since removed from storage and installed.
  3. Material stored following previous report and remaining in storage.
- C. Site Condition Reports: Immediately on discovery of a difference between site conditions and the Contract Documents, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

## 2.5 SPECIAL REPORTS

- A. General: Submit special reports directly to Owner within one day of an occurrence. Distribute copies of report 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. Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
1. Meetings: Scheduling consultant shall attend all meetings related to Project progress, alleged delays, and time impact.
- B. 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 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 final completion percentage for each activity.
- C. 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 3200

## SECTION 01 3233 - PHOTOGRAPHIC DOCUMENTATION

### 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 the following:
  - 1. Preconstruction photographs.
  - 2. Periodic construction photographs.
  - 3. Final completion construction photographs.
- B. Related Requirements:
  - 1. Section 01 3300 "Submittal Procedures" for submitting photographic documentation.
  - 2. Section 01 7700 "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
  - 3. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
  - 4. Section 02 4119 "Selective Structure Demolition" for photographic documentation before selective demolition operations commence.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Key Plan: Submit key plan of Project site and building with notation of vantage points marked for location and direction of each photograph. Indicate elevation or story of construction. Include same information as corresponding photographic documentation.
- B. Digital Photographs: Submit image files within three days of taking photographs.
  - 1. Digital Camera: Minimum sensor resolution of 8 megapixels.
  - 2. Format: Minimum 3200 by 2400 pixels, 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 contact information for 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.

#### 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 8 megapixels, and at an image resolution of not less than 3200 by 2400 pixels.

### PART 3 - EXECUTION

#### 3.1 CONSTRUCTION PHOTOGRAPHS

- A. Photographer: Engage an adequate photographer to take construction photographs.
- B. 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.
- C. 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 file name for each image.
  - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Architect.
- D. Preconstruction Photographs: Before commencement of excavation, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
  - 1. Take 20 photographs to show existing conditions adjacent to property before starting the Work.
  - 2. Take 20 photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.

3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.
- E. Periodic Construction Photographs: Take 20 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.
- F. Architect-Directed Construction Photographs: From time to time, Architect will instruct photographer about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since last photographs were taken.
- G. Final Completion Construction Photographs: Take 20 color photographs after date of Substantial Completion for submission as project record documents. Architect will inform photographer of desired vantage points.
  1. Do not include date stamp.

END OF SECTION 01 3233

## SECTION 01 3300 - SUBMITTAL PROCEDURES

### 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 requirements for the submittal schedule and administrative and procedural requirements for submitting Shop Drawings, Product Data, Samples, and other submittals.
- B. Related Requirements:
  - 1. Section 01 2900 "Payment Procedures" for submitting Applications for Payment and the schedule of values.
  - 2. Section 01 3200 "Construction Progress Documentation" for submitting schedules and reports, including Contractor's construction schedule.
  - 3. Section 01 7823 "Operation and Maintenance Data" for submitting operation and maintenance manuals.
  - 4. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 5. Section 01 7900 "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.

#### 1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Architect's responsive action. Action submittals are those submittals indicated in individual Specification Sections as "action submittals."
- B. Informational Submittals: Written and graphic information and physical samples that do not require Architect's responsive action. Submittals may be rejected for not complying with requirements. Informational submittals are those submittals indicated in individual Specification Sections as "informational submittals."
- C. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.

#### 1.4 ACTION SUBMITTALS

- A. Submittal Schedule: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or revisions to submittals noted by Architect and additional time for handling and reviewing submittals required by those corrections.
1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
  2. Initial Submittal: Submit concurrently with startup construction schedule. Include submittals required during the first 60 days of construction. List those submittals 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.
    - a. Submit revised submittal schedule to reflect changes in current status and timing for submittals.
  4. Format: Arrange the following information in a tabular format:
    - a. Scheduled date for first submittal.
    - b. Specification Section number and title.
    - c. Submittal category: Action; informational.
    - d. Name of subcontractor.
    - e. Description of the Work covered.
    - f. Scheduled date for Architect's final release or approval.
    - g. Scheduled date of fabrication.
    - h. Scheduled dates for purchasing.
    - i. Scheduled dates for installation.
    - j. Activity or event number.

#### 1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Architect's Digital Data Files: Electronic digital data files of the Contract Drawings will be provided by Architect for Contractor's use in preparing submittals.
1. Architect will furnish Contractor one set of digital data drawing files of the Contract Drawings for use in preparing Shop Drawings and Project record drawings.
    - a. Architect makes no representations as to the accuracy or completeness of digital data drawing files as they relate to the Contract Drawings.
    - b. Contractor shall execute a data licensing agreement in the form of Agreement form acceptable to Owner and Architect.
    - c. The following digital data files will be furnished for each appropriate discipline:
      - 1) Floor plans.
      - 2) Reflected ceiling plans.



- B. 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. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
  3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
  4. 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.
- C. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Architect's receipt of submittal. No extension of the Contract Time will be authorized because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.
1. Initial Review: Allow 15 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Architect will advise Contractor when a submittal being processed must be delayed for coordination.
  2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
  3. Resubmittal Review: Allow 15 days for review of each resubmittal.
  4. Sequential Review: Where sequential review of submittals by Architect's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- D. Paper Submittals: Place a permanent label or title block on each submittal item for identification.
1. Indicate name of firm or entity that prepared each submittal on label or title block.
  2. Provide a space approximately 6 by 8 inches on label or beside title block to record Contractor's review and approval markings and action taken by Architect.
  3. Include the following information for processing and recording action taken:
    - a. Project name.
    - b. Date.
    - c. Name of Architect.
    - d. Name of Contractor.
    - e. Name of subcontractor.
    - f. Name of supplier.
    - g. Name of manufacturer.
    - h. Submittal number or other unique identifier, including revision identifier.
    - 1) Submittal number shall use Specification Section number followed by a decimal point and then a sequential number (e.g., 061000.01). Resubmittals

shall include an alphabetic suffix after another decimal point (e.g., 061000.01.A).

- i. Number and title of appropriate Specification Section.
  - j. Drawing number and detail references, as appropriate.
  - k. Location(s) where product is to be installed, as appropriate.
  - l. Other necessary identification.
4. Additional Paper Copies: Unless additional copies are required for final submittal, and unless Architect observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
  - a. Submit one copy of submittal to concurrent reviewer in addition to specified number of copies to Architect.
5. Transmittal for Paper Submittals: Assemble each submittal individually and appropriately for transmittal and handling. Transmit each submittal using a transmittal form. Architect will discard submittals received from sources other than Contractor.
  - a. Transmittal Form for Paper Submittals: Use AIA Document G810.
  - b. Transmittal Form for Paper Submittals: Provide locations on form for the following information:
    - 1) Project name.
    - 2) Date.
    - 3) Destination (To:).
    - 4) Source (From:).
    - 5) Name and address of Architect.
    - 6) Name of Construction Manager.
    - 7) Name of Contractor.
    - 8) Name of firm or entity that prepared submittal.
    - 9) Names of subcontractor, manufacturer, and supplier.
    - 10) Category and type of submittal.
    - 11) Submittal purpose and description.
    - 12) Specification Section number and title.
    - 13) Specification paragraph number or drawing designation and generic name for each of multiple items.
    - 14) Drawing number and detail references, as appropriate.
    - 15) Indication of full or partial submittal.
    - 16) Transmittal number, numbered consecutively.
    - 17) Submittal and transmittal distribution record.
    - 18) Remarks.
    - 19) Signature of transmitter.
- E. Electronic Submittals: Identify and incorporate information in each electronic submittal file as follows:
  1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.

2. Name file with submittal number or other unique identifier, including revision identifier.
    - a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., LNHS-061000.01). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., LNHS-061000.01.A).
  3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect.
  4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Owner, containing the following information:
    - a. Project name.
    - b. Date.
    - c. Name and address of Architect.
    - d. Name of Construction Manager.
    - e. Name of Contractor.
    - f. Name of firm or entity that prepared submittal.
    - g. Names of subcontractor, manufacturer, and supplier.
    - h. Category and type of submittal.
    - i. Submittal purpose and description.
    - j. Specification Section number and title.
    - k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    - l. Drawing number and detail references, as appropriate.
    - m. Location(s) where product is to be installed, as appropriate.
    - n. Related physical samples submitted directly.
    - o. Indication of full or partial submittal.
    - p. Transmittal number, numbered consecutively.
    - q. Submittal and transmittal distribution record.
    - r. Other necessary identification.
    - s. Remarks.
  5. Metadata: Include the following information as keywords in the electronic submittal file metadata:
    - a. Project name.
    - b. Number and title of appropriate Specification Section.
    - c. Manufacturer name.
    - d. Product name.
- F. Options: Identify options requiring selection by Architect.
- G. Deviations and Additional Information: 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 in the Contract Documents, including minor variations and limitations. Include same identification information as related submittal.

- H. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
  - 1. Note date and content of previous submittal.
  - 2. Note date and content of revision in label or title block and clearly indicate extent of revision.
  - 3. Resubmit submittals until they are marked with approval notation from Architect's action stamp.
- I. 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.
- J. Use for Construction: Retain complete copies of submittals on Project site. Use only final action submittals that are marked with approval notation from Architect's action stamp.

## PART 2 - PRODUCTS

### 2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
  - 1. Post electronic submittals as PDF electronic files directly to Project Web site specifically established for Project.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
  - 2. Submit electronic submittals via email as PDF electronic files.
    - a. Architect will return annotated file. Annotate and retain one copy of file as an electronic Project record document file.
  - 3. Action Submittals: Submit three paper copies of each submittal unless otherwise indicated. Architect will return two copies.
  - 4. Informational Submittals: Submit two paper copies of each submittal unless otherwise indicated. Architect will not return copies.
  - 5. Certificates and Certifications Submittals: Provide a statement that includes signature of entity responsible for preparing certification. Certificates and certifications shall be signed by an officer or other individual authorized to sign documents on behalf of that entity.
    - a. Provide a digital signature with digital certificate on electronically submitted certificates and certifications where indicated.
    - b. Provide a notarized statement on original paper copy certificates and certifications where indicated.

- 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 published 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.
  3. Include the following information, as applicable:
    - a. Manufacturer's catalog cuts.
    - b. Manufacturer's product specifications.
    - c. Standard color charts.
    - d. Statement of compliance with specified referenced standards.
    - e. Testing by recognized testing agency.
    - f. Application of testing agency labels and seals.
    - g. Notation of coordination requirements.
    - h. Availability and delivery time information.
  4. For equipment, include the following in addition to the above, as applicable:
    - a. Wiring diagrams showing factory-installed wiring.
    - b. Printed performance curves.
    - c. Operational range diagrams.
    - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
  5. Submit Product Data before or concurrent with Samples.
  6. Submit Product Data in the following format:
    - a. PDF electronic file.
- 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, unless submittal based on Architect's digital data drawing files is otherwise permitted.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
    - a. Identification of products.
    - b. Schedules.
    - c. Compliance with specified standards.
    - d. Notation of coordination requirements.
    - e. Notation of dimensions established by field measurement.
    - f. Relationship and attachment to adjoining construction clearly indicated.
    - g. Seal and signature of professional engineer if specified.
  2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches, but no larger than 30 by 42 inches.
  3. Submit Shop Drawings in the following format:
    - a. PDF electronic file.

- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these characteristics between submittal and actual component as delivered and installed.
1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
  2. Identification: Attach label on unexposed side of Samples that includes the following:
    - a. Generic description of Sample.
    - b. Product name and name of manufacturer.
    - c. Sample source.
    - d. Number and title of applicable Specification Section.
    - e. Specification paragraph number and generic name of each item.
  3. For projects where electronic submittals are required, provide corresponding electronic submittal of Sample transmittal, digital image file illustrating Sample characteristics, and identification information for record.
  4. 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 that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
    - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
  5. 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. Number of Samples: Submit one full set(s) 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.
  6. Samples for Verification: Submit full-size units or Samples of size indicated, prepared from same material to be used for the Work, cured and finished in manner specified, and physically identical with material or 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.
    - a. Number of Samples: 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.
      - 1) Submit a single Sample where assembly details, workmanship, fabrication techniques, connections, operation, and other similar characteristics are to be demonstrated.

- 2) If variation in color, pattern, texture, or other characteristic is inherent in material or product represented by a Sample, submit at least three sets of paired units that show approximate limits of variations.
- E. Product Schedule: As required in individual Specification Sections, 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 indicated in the Contract Documents or assigned by Contractor if none is indicated.
  2. Manufacturer and product name, and model number if applicable.
  3. Number and name of room or space.
  4. Location within room or space.
  5. Submit product schedule in the following format:
    - a. PDF electronic file.
- F. Coordination Drawing Submittals: Comply with requirements specified in Section 01 3100 "Project Management and Coordination."
- G. Contractor's Construction Schedule: Comply with requirements specified in Section 01 3200 "Construction Progress Documentation."
- H. Application for Payment and Schedule of Values: Comply with requirements specified in Section 01 2900 "Payment Procedures."
- I. Test and Inspection Reports and Schedule of Tests and Inspections Submittals: Comply with requirements specified in Section 01 4000 "Quality Requirements."
- J. Closeout Submittals and Maintenance Material Submittals: Comply with requirements specified in Section 01 7700 "Closeout Procedures."
- K. Maintenance Data: Comply with requirements specified in Section 01 7823 "Operation and Maintenance Data."
- L. Qualification Data: Prepare written information that demonstrates capabilities and experience of firm or person. Include lists of completed projects with project names and addresses, contact information of architects and owners, and other information specified.
- M. Welding Certificates: Prepare written certification that welding procedures and personnel comply with requirements in the Contract Documents. Submit record of Welding Procedure Specification and Procedure Qualification Record on AWS forms. Include names of firms and personnel certified.
- N. Installer Certificates: Submit written statements on manufacturer's letterhead certifying that Installer complies with requirements in the Contract Documents and, where required, is authorized by manufacturer for this specific Project.

- O. Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that manufacturer complies with requirements in the Contract Documents. Include evidence of manufacturing experience where required.
- P. Product Certificates: Submit written statements on manufacturer's letterhead certifying that product complies with requirements in the Contract Documents.
- Q. Material Certificates: Submit written statements on manufacturer's letterhead certifying that material complies with requirements in the Contract Documents.
- R. Material Test Reports: Submit reports written by a qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements in the Contract Documents.
- S. Product Test Reports: Submit written reports indicating that current product produced by manufacturer complies with requirements in the Contract Documents. 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.
- T. Research Reports: Submit written evidence, from a model code organization acceptable to authorities having jurisdiction, that product complies with building code in effect for Project. Include the following information:
  - 1. Name of evaluation organization.
  - 2. Date of evaluation.
  - 3. Time period when report is in effect.
  - 4. Product and manufacturers' names.
  - 5. Description of product.
  - 6. Test procedures and results.
  - 7. Limitations of use.
- U. Preconstruction Test Reports: Submit 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 in the Contract Documents.
- V. Compatibility Test Reports: Submit 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.
- W. Field Test Reports: Submit written reports 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 in the Contract Documents.
- X. Design Data: Prepare and submit 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.



## 2.2 DELEGATED-DESIGN SERVICES

- A. 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.
- B. Delegated-Design Services Certification: In addition to Shop Drawings, Product Data, and other required submittals, submit digitally signed PDF electronic file paper copies of certificate, 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. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Architect.
- B. Project Closeout and Maintenance Material Submittals: See requirements in Section 01 7700 "Closeout Procedures."
- C. 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.

### 3.2 ARCHITECT'S ACTION

- A. Action Submittals: Architect will review each submittal, make marks to indicate corrections or revisions required, and return it. Architect will stamp each submittal with an action stamp and will mark stamp appropriately to indicate action, as follows:
  - 1. "Conforms": Submittal appears to conform to the intent of the construction requirements; or with minor changes as noted (notes) will meet the intent of the construction documents. The submittal may be used for work on the project as noted.
  - 2. "Notes": The submittal includes information that must be modified on the submittal for it to conform to the intent of the construction documents.

3. "Revise and Resubmit": The submittal must be revised in accordance with comments noted and resubmitted for review. The submittal may not be used for work on the project.
  4. "Does Not Conform": The submittal may not be used for work on the project.
- B. Informational Submittals: Architect will review each submittal and will not return it, or will return it if it does not comply with requirements. Architect will forward each submittal to appropriate party.
- C. Partial submittals prepared for a portion of the Work will be reviewed when use of partial submittals has received prior approval from Architect.
- D. Incomplete submittals are unacceptable, will be considered nonresponsive, and will be returned for resubmittal without review.
- E. Submittals not required by the Contract Documents may be returned by the Architect without action.

END OF SECTION 01 3300

## SECTION 01 4000 - QUALITY REQUIREMENTS

### 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 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, or authorities having jurisdiction are not limited by provisions of this Section.

#### 1.3 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.
- 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).
- J. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

#### 1.4 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.

## 1.5 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.

## 1.6 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. Contractor's Statement of Responsibility: When required by authorities having jurisdiction, submit copy of written statement of responsibility sent to authorities having jurisdiction before starting work on the following systems:
  - 1. Seismic-force-resisting system, designated seismic system, or component listed in the designated seismic system quality-assurance plan prepared by Architect.
  - 2. Main wind-force-resisting system or a wind-resisting component listed in the wind-force-resisting system quality-assurance plan prepared by Architect.
- D. 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.
- E. 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.

## 1.7 CONTRACTOR'S QUALITY-CONTROL PLAN

- A. Quality-Control Plan, General: Submit quality-control plan within 10 days of Notice of Award, 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.
- 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.

## 1.8 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 reinspecting.
- 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.
- 1.9 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. **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.
- F. **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.
- G. **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.
- H. **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.
- I. **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, and 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.
- J. 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.
- K. Integrated Exterior Mockups: Construct integrated exterior mockup according to approved Shop Drawings. Coordinate installation of exterior envelope materials and products for which mockups are required in individual Specification Sections, along with supporting materials.
- A. Laboratory Mockups: Comply with requirements of preconstruction testing and those specified in individual Specification Sections.
- 1.10 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. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.
- 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 3300 "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 preinstallation 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/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, 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.

#### 1.11 SPECIAL TESTS AND INSPECTIONS

- A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:
1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviews the completeness and adequacy of those procedures to perform the Work.
  2. Notifying Architect, Commissioning Authority, and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
  3. 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.
  4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
  5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
  6. Retesting and reinspecting 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 Section 01 3300 "Submittal Procedures."
- 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 4000

## SECTION 01 5000 - TEMPORARY FACILITIES AND CONTROLS

### 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 requirements for temporary utilities, support facilities, and security and protection facilities.
- B. Related Requirements:
  - 1. Section 01 1000 "Summary" for work restrictions and limitations on utility interruptions.

#### 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, testing agencies, and authorities having jurisdiction.
- 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 from Existing System: Electric power from Owner's existing system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.
- B. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.
- C. Moisture-Protection Plan: Describe procedures and controls for protecting materials and construction from water absorption and damage.

1. Describe delivery, handling, and storage provisions for materials subject to water absorption or water damage.
  2. Indicate procedures for discarding water-damaged materials, protocols for mitigating water intrusion into completed Work, and replacing water-damaged Work.
  3. Indicate sequencing of work that requires water, such as sprayed fire-resistive materials, and acoustical plastering, and describe plans for dealing with water from these operations. Show procedures for verifying that wet construction has dried sufficiently to permit installation of finish materials.
- D. Dust- and HVAC-Control Plan: Submit coordination drawing and narrative that indicates the dust- and HVAC-control measures proposed for use, proposed locations, and proposed time frame for their operation. Identify further options if proposed measures are later determined to be inadequate. Include the following:
1. Locations of dust-control partitions at each phase of work.
  2. HVAC system isolation schematic drawing.
  3. Location of proposed air-filtration system discharge.
  4. Waste handling procedures.
  5. Other dust-control measures.

## 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.

## 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.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. 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 rails.

## 2.2 TEMPORARY FACILITIES

- A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.
- B. Common-Use Field Office: Of sufficient size to accommodate needs of Owner, Architect, and construction personnel office activities and to accommodate Project meetings specified in other Division 01 Sections. 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. Conference room of sufficient size to accommodate meetings of 10 individuals. Provide electrical power service and 120-V ac duplex receptacles, with no fewer than one receptacle on each wall. Furnish room with conference table, chairs, and 4-foot- square tack and marker boards.
  - 3. Drinking water and private toilet.
  - 4. Coffee machine and supplies.
  - 5. Heating and cooling equipment necessary to maintain a uniform indoor temperature of 68 to 72 deg F.
  - 6. Lighting fixtures capable of maintaining average illumination of 20 fc at desk height.
- C. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.
  - 1. Store combustible materials apart from building.

## 2.3 EQUIPMENT

- A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.
- B. HVAC Equipment: Unless Owner authorizes use of permanent HVAC 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 for type of fuel being consumed, by a qualified testing agency acceptable to authorities having jurisdiction, and marked for intended location and application.
  - 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 Section 01 7700 "Closeout Procedures."
- C. Air-Filtration Units: Primary and secondary HEPA-filter-equipped portable units with four-stage filtration. Provide single switch for emergency shutoff. Configure to run continuously.

## 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 by progress of the Work.
- B. Provide each facility ready for use when needed to avoid delay. 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.
  - 1. Arrange with utility company, Owner, and existing users for time when service can be interrupted, if necessary, to make connections for temporary services.
- B. Sewers and Drainage: Provide temporary utilities to remove effluent lawfully.
  - 1. Connect temporary sewers to municipal system as directed by authorities having jurisdiction.
  - 2. Provide Storm Water Pollution Prevention (SWPP) plan.
- C. Water Service: Connect to Owner's existing water service facilities. Clean and maintain water service facilities in a condition acceptable to Owner. At Substantial Completion, restore these facilities to condition existing before initial use.
- D. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with requirements of authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.
  - 1. Toilets: Use of Owner's existing toilet 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.
- E. Heating and Cooling: Provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed.
- F. Isolation of Work Areas in Occupied Facilities: Prevent dust, fumes, and odors from entering occupied areas.
  - 1. Prior to commencing work, isolate the HVAC system in area where work is to be performed according to coordination drawings.



- a. Disconnect supply and return ductwork in work area from HVAC systems servicing occupied areas.
    - b. Maintain negative air pressure within work area using HEPA-equipped air-filtration units, starting with commencement of temporary partition construction, and continuing until removal of temporary partitions is complete.
  2. Perform daily construction cleanup and final cleanup using approved, HEPA-filter-equipped vacuum equipment.
- 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 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: Connect to Owner's existing electric power service. Maintain equipment in a condition acceptable to Owner.
- I. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
  1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.
  2. Install lighting for Project identification sign.
- J. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.
  1. Provide additional telephone lines for the following:
    - a. Provide a dedicated telephone line for each facsimile machine in each field office.
  2. At each telephone, post a list of important telephone numbers.
    - a. Police and fire departments.
    - b. Ambulance service.
    - c. Contractor's home office.
    - d. Contractor's emergency after-hours telephone number.
    - e. Architect's office.
    - f. Engineers' offices.
    - g. Owner's office.
    - h. Principal subcontractors' field and home offices.
  3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

- K. Electronic Communication Service: Provide a desktop computer in the primary field office adequate for use by Architect and Owner to access Project electronic documents and maintain electronic communications. Equip computer with not less than the following:
1. Processor: Intel Pentium D or Intel CoreDuo, 3.0 GHz processing speed.
  2. Memory: 4 gigabyte.
  3. Disk Storage: 300 gigabyte hard-disk drive and combination DVD-RW/CD-RW drive.
  4. Display: 22-inch LCD monitor with 256-Mb dedicated video RAM.
  5. Full-size keyboard and mouse.
  6. Network Connectivity: 10/100BaseT Ethernet.
  7. Operating System: Microsoft Windows XP Professional or Microsoft Windows Vista Business.
  8. Productivity Software:
    - a. Microsoft Office Professional, XP or higher, including Word, Excel, and Outlook.
    - b. Adobe Reader 7.0 or higher.
    - c. WinZip 7.0 or higher.
  9. Printer: "All-in-one" unit equipped with printer server, combining color printing, photocopying, scanning, and faxing, or separate units for each of these three functions.
  10. Internet Service: Broadband modem, router and ISP, equipped with hardware firewall, providing minimum 384 Kbps upload and 1 Mbps download speeds at each computer.
  11. Internet Security: Integrated software, providing software firewall, virus, spyware, phishing, and spam protection in a combined application.
  12. Backup: External hard drive, minimum 40 gigabyte, with automated backup software providing daily backups.

### 3.3 SUPPORT FACILITIES INSTALLATION

- A. General: Comply with the following:
1. 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.
  2. Maintain support facilities until Architect schedules Substantial Completion inspection. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.
- B. Temporary Use of Permanent Roads and Paved Areas: Locate temporary roads and paved areas in same location as permanent roads and paved areas. Construct and maintain temporary roads and paved areas adequate for construction operations. 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 subbase and base for temporary roads and paved areas according to Section 31 2000 "Earth Moving."

3. Recondition base after temporary use, including removing contaminated material, regrading, proofrolling, compacting, and testing.
  - C. Traffic Controls: 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. Parking: Provide temporary parking areas for construction personnel.
  - E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. 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 properties or endanger permanent Work or temporary facilities.
    2. Remove snow and ice as required to minimize accumulations.
  - F. Project Signs: Provide Project signs as indicated. Unauthorized signs are not permitted.
    1. Identification Signs: Provide Project identification signs as indicated on Drawings.
    2. Temporary Signs: Provide other signs as indicated and as required to inform public and individuals seeking entrance to Project.
      - a. Provide temporary, directional signs for construction personnel and visitors.
    3. Maintain and touchup signs so they are legible at all times.
  - G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with progress cleaning requirements in Section 01 7300 "Execution."
  - H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
    1. Truck cranes and similar devices used for hoisting materials are considered "tools and equipment" and not temporary facilities.
- 3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION
- A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.
  - B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.
    1. Comply with work restrictions specified in Section 01 1000 "Summary."

- C. Temporary Erosion and Sedimentation Control: Comply with requirements specified in Section 31 1000 "Site Clearing."
- D. Stormwater Control: Comply with requirements of authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
- E. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.
- F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates.
  - 1. Extent of Fence: As required to enclose entire Project site or portion determined sufficient to accommodate construction operations.
  - 2. Maintain security by limiting number of keys and restricting distribution to authorized personnel. Furnish one set of keys to Owner.
- G. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.
- H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.
- I. Temporary Egress: Maintain temporary egress from existing occupied facilities as indicated and as required by authorities having jurisdiction.
- J. 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 incomplete, insulate temporary enclosures.
- K. Temporary Fire Protection: Install and maintain temporary fire-protection facilities of types needed to protect against reasonably predictable and controllable fire losses. Comply with NFPA 241; manage fire-prevention program.
  - 1. Prohibit smoking in construction areas.
  - 2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
  - 3. Develop and supervise an overall fire-prevention and -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.
  - 4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

### 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.
- 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.

### 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.
  - 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.
- C. Operate Project-identification-sign lighting daily from dusk until 12:00 midnight.
- D. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.
- E. 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 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, repair, renovate, and clean permanent facilities used during construction period. Comply with final cleaning requirements specified in Section 01 7700 "Closeout Procedures."

INDIAN HILLS MIDDLE SCHOOL  
1180 East Sanders Road, Sandy, UT 84094  
Canyons School District

100% Construction Documents

END OF SECTION 01 5000

## SECTION 01 6000 - PRODUCT REQUIREMENTS

### 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 selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Requirements:
  - 1. Section 01 2500 "Substitution Procedures" for requests for substitutions.

#### 1.3 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.

#### 1.4 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.
  - 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 Section 01 3300 "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 Section 01 3300 "Submittal Procedures." Show compliance with requirements.

#### 1.5 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.

#### 1.6 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 weathertight 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.

## 1.7 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 Section 01 7700 "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.
6. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article to obtain approval for use of an unnamed product.

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 not be considered.
  - b. Nonrestricted List: Where Specifications include a list of names of both available manufacturers and products, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed product.
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 not be considered.
  - b. Nonrestricted List: Where Specifications include a list of available manufacturers, provide a product by one of the manufacturers listed, or a product by an unnamed manufacturer, that complies with requirements. Comply with requirements in "Comparable Products" Article for consideration of an unnamed manufacturer's product.
5. Basis-of-Design Product: Where Specifications name a product, or refer to a product indicated on Drawings, and include a list of manufacturers, 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 Section 01 2500 "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. 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 Used)

END OF SECTION 01 6000

## SECTION 01 7300 - EXECUTION

### 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 general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
  - 1. Construction layout.
  - 2. Field engineering and surveying.
  - 3. Installation of the Work.
  - 4. Cutting and patching.
  - 5. Progress cleaning.
  - 6. Starting and adjusting.
  - 7. Protection of installed construction.
  - 8. Correction of the Work.
- B. Related Requirements:
  - 1. Section 01 1000 "Summary" for limits on use of Project site.
  - 2. Section 01 3300 "Submittal Procedures" for submitting surveys.
  - 3. Section 02 4119 "Selective Structure Demolition" for demolition and removal of selected portions of the building.

#### 1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For professional engineer.
- B. Certificates: Submit certificate signed by professional engineer certifying that location and elevation of improvements comply with requirements.

- C. Cutting and Patching Plan: Submit plan describing procedures at least 10 days prior to the time cutting and patching will be performed. Include the following information:
1. Extent: Describe reason for and extent of each occurrence of cutting and patching.
  2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building appearance and other significant visual elements.
  3. Products: List products to be used for patching and firms or entities that will perform patching work.
  4. Dates: Indicate when cutting and patching will be performed.
  5. Utilities and Mechanical and Electrical Systems: List services and systems that cutting and patching procedures will disturb or affect. List services and systems that will be relocated and those that will be temporarily out of service. Indicate length of time permanent services and systems will be disrupted.
    - a. Include description of provisions for temporary services and systems during interruption of permanent services and systems.
- D. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

## 1.5 QUALITY ASSURANCE

- A. Cutting and Patching: Comply with requirements for and limitations on cutting and patching of construction elements.
1. Structural Elements: When cutting and patching structural elements, notify Architect of locations and details of cutting and await directions from Architect before proceeding. Shore, brace, and support structural elements during cutting and patching. Do not cut and patch structural elements in a manner that could change their load-carrying capacity or increase deflection
  2. 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.
  3. Other Construction Elements: Do not cut and patch other construction elements or 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.
  4. Visual Elements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch exposed construction 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.
- B. 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.

- C. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

- A. General: Comply with requirements specified in other Sections.
- B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
  - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Existing Conditions: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify the existence and location of underground utilities, mechanical and electrical systems, and other construction affecting the Work.
  - 1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; underground electrical services, and other utilities.
  - 2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.
- B. Examination and Acceptance of Conditions: Before proceeding with each component of the Work, 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. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
  - 2. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
  - 3. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
- C. Written Report: Where a written report listing conditions detrimental to performance of the Work is required by other Sections, include the following:

1. Description of the Work.
2. List of detrimental conditions, including substrates.
3. List of unacceptable installation tolerances.
4. Recommended corrections.

- D. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

### 3.2 PREPARATION

- A. Existing Utility Information: Furnish information to Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. 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.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately on discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of Contractor, submit a request for information to Architect according to requirements in Section 01 3100 "Project Management and Coordination."

### 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 professional engineer 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 limits on use of Project site.
  3. Establish dimensions within tolerances indicated. Do not scale Drawings to obtain required dimensions.
  4. Inform installers of lines and levels to which they must comply.
  5. Check the location, level and plumb, of every major element as the Work progresses.
  6. Notify Architect when deviations from required lines and levels exceed allowable tolerances.
  7. Close site surveys with an error of closure equal to or less than the standard established by authorities having jurisdiction.

- C. 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.

### 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, 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 96 inches in occupied spaces and 90 inches in unoccupied spaces.
- 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. Sequence the Work and allow adequate clearances to accommodate movement of construction items on site and placement in permanent locations.
- F. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- G. 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.
- H. Attachment: Provide blocking and attachment plates and anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
  - 1. Mounting Heights: Where mounting heights are not indicated, 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.
- I. 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.
- J. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

### 3.6 CUTTING AND PATCHING

- A. Cutting and Patching, General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
  - 1. Cut in-place 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.
- B. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- C. Temporary Support: Provide temporary support of work to be cut.

- D. Protection: Protect in-place 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.
- E. Cutting: Cut in-place 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 neatly to minimum size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
  - 2. 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.
- F. 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 practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
  - 1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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 minimize 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 in-place 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, prepare substrate and apply primer and intermediate paint coats appropriate for substrate 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 in-place 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 and ensures thermal and moisture integrity of building enclosure.
- G. Cleaning: Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

### 3.7 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily, including common areas. Enforce requirements strictly. Dispose of materials lawfully.
  - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
  - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 deg F.
  - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
    - a. Use containers intended for holding waste materials of type to be stored.
- 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 in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Section 01 5000 "Temporary Facilities and Controls."
- H. 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.

- I. 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.
- J. 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. Coordinate startup and adjusting of equipment and operating components with requirements in Section 01 9113 "General Commissioning Requirements."
- B. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.
- C. Adjust equipment for proper operation. Adjust operating components for proper operation without binding.
- 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: Comply with qualification requirements in Section 01 4000 "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.

END OF SECTION 01 7300

## SECTION 01 7700 - CLOSEOUT PROCEDURES

### 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 contract closeout, including, but not limited to, the following:
  - 1. Substantial Completion procedures.
  - 2. Final completion procedures.
  - 3. Warranties.
  - 4. Final cleaning.
  - 5. Repair of the Work.
- B. Related Requirements:
  - 1. Section 01 3233 "Photographic Documentation" for submitting final completion construction photographic documentation.
  - 2. Section 01 7300 "Execution" for progress cleaning of Project site.
  - 3. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.
  - 4. Section 01 7839 "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.
  - 5. Section 01 7900 "Demonstration and Training" for requirements for instructing Owner's personnel.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For cleaning agents.
- B. Contractor's List of Incomplete Items: Initial submittal at Substantial Completion.
- C. Certified List of Incomplete Items: Final submittal at Final Completion.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Certificates of Release: From authorities having jurisdiction.
- B. Certificate of Insurance: For continuing coverage.

- C. Field Report: For pest control inspection.

## 1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Schedule of Maintenance Material Items: For maintenance material submittal items specified in other Sections.

## 1.6 SUBSTANTIAL COMPLETION PROCEDURES

- A. Contractor's List of Incomplete Items: Prepare and submit a list of items to be completed and corrected (Contractor's punch list), indicating the value of each item on the list and reasons why the Work is incomplete.
- B. Submittals Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Certificates of Release: Obtain and submit releases from authorities having jurisdiction permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
  - 2. Submit closeout submittals specified in other Division 01 Sections, including project record documents, operation and maintenance manuals, final completion construction photographic documentation, damage or settlement surveys, property surveys, and similar final record information.
  - 3. Submit closeout submittals specified in individual Divisions 02 through 33 Sections, including specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
  - 4. Submit maintenance material submittals specified in individual Divisions 02 through 33 Sections, including tools, spare parts, extra materials, and similar items, and deliver to location designated by Architect. Label with manufacturer's name and model number where applicable.
    - a. Schedule of Maintenance Material Items: Prepare and submit schedule of maintenance material submittal items, including name and quantity of each item and name and number of related Specification Section. Obtain Architect's signature for receipt of submittals.
  - 5. Submit test/adjust/balance records.
  - 6. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
- C. Procedures Prior to Substantial Completion: Complete the following a minimum of 10 days prior to requesting inspection for determining date of Substantial Completion. List items below that are incomplete at time of request.
  - 1. Advise Owner of pending insurance changeover requirements.
  - 2. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.

3. Complete startup and testing of systems and equipment.
4. Perform preventive maintenance on equipment used prior to Substantial Completion.
5. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems. Submit demonstration and training video recordings specified in Division 01 Section "Demonstration and Training."
6. Advise Owner of changeover in heat and other utilities.
7. Participate with Owner in conducting inspection and walkthrough with local emergency responders.
8. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
9. Complete final cleaning requirements, including touchup painting.
10. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

D. Inspection: Submit a written request for inspection to determine Substantial Completion a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. 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. Reinspection: Request reinspection 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.

## 1.7 FINAL COMPLETION PROCEDURES

A. Submittals Prior to Final Completion: Before requesting final inspection for determining final completion, complete the following:

1. Submit a final Application for Payment according to Section 01 2900 "Payment Procedures."
2. Certified List of Incomplete Items: Submit certified copy of Architect's Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. Certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Certificate of Insurance: Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Submit pest-control final inspection report.

B. Inspection: Submit a written request for final inspection to determine acceptance a minimum of 10 days prior to date the work will be completed and ready for final inspection and tests. 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. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

## 1.8 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

- A. Organization 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.
1. Organize list of spaces in sequential order, starting with exterior areas first.
  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.
  4. Submit list of incomplete items in the following format:
    - a. PDF electronic file. Architect will return annotated file.

## 1.9 SUBMITTAL OF PROJECT WARRANTIES

- A. Time of Submittal: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated, or when delay in submittal of warranties might limit Owner's rights under warranty.
- B. Organize warranty documents into an orderly sequence based on the table of contents of Project Manual.
1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
  2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
  3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.
  4. Warranty Electronic File: Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide bookmarked table of contents at beginning of document.
- C. Provide additional copies of each warranty to include in operation and maintenance manuals.



## 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 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution 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. 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 designated 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. Remove snow and ice to provide safe access to building.
    - f. 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.
    - g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
    - h. Sweep concrete floors broom clean in unoccupied spaces.
    - i. Vacuum carpet and similar soft surfaces, removing debris and excess nap; clean according to manufacturer's recommendations 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. Polish mirrors and glass, taking care not to scratch surfaces.
    - k. Remove labels that are not permanent.

- l. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
  - m. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
  - n. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.
  - o. Clean ducts, blowers, and coils if units were operated without filters during construction or that display contamination with particulate matter on inspection.
    - 1) Clean HVAC system in compliance with NADCA Standard 1992-01. Provide written report on completion of cleaning.
  - p. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.
  - q. Leave Project clean and ready for occupancy.
- C. Construction Waste Disposal: Comply with waste disposal requirements in Section 01 5000 "Temporary Facilities and Controls."

### 3.2 REPAIR OF THE WORK

- A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.
- B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.
  - 1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.
  - 2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that already show evidence of repair or restoration.
    - a. Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates. Remove paint applied to required labels and identification.
  - 3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
  - 4. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 7700

## SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

### 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 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. Product maintenance manuals.
  - 5. Systems and equipment maintenance manuals.
- B. Related Requirements:
  - 1. Section 01 3300 "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
  - 2. Section 01 9113 "General Commissioning Requirements" for verification and compilation of data into operation and maintenance manuals.

#### 1.3 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.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.
  - 1. Architect and Commissioning Authority will comment on whether content of operations and maintenance submittals are acceptable.
  - 2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

- B. Format: Submit operations and maintenance manuals in the following format:
  - 1. PDF electronic file. Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect.
    - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
    - b. Enable inserted reviewer comments on draft submittals.
  - 2. Three paper copies. Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves. Architect will return two copies.
- C. Initial Manual Submittal: Submit draft copy of each manual at least 30 days before commencing demonstration and training. Architect and Commissioning Authority will comment on whether general scope and content of manual are acceptable.
- D. Final Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Architect and Commissioning Authority will return copy with comments.
  - 1. Correct or revise each manual to comply with Architect's and Commissioning Authority's comments. Submit copies of each corrected manual within 15 days of receipt of Architect's and Commissioning Authority's comments and prior to commencing demonstration and training.

## PART 2 - PRODUCTS

### 2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information. 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 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 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

- 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: 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 and contact information for Contractor.
  - 6. Name and contact information for Architect.
  - 7. Name and contact information for Commissioning Authority.
  - 8. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
  - 9. 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.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
  - 1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
  - 2. File Names and Bookmarks: Enable bookmarking of individual documents based on file names. Name document files to correspond to system, subsystem, and equipment names

used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel on opening file.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-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, and indicate Specification Section number on bottom of spine. Indicate volume number for multiple-volume sets.
2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. 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 storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch 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. Use designations for systems and equipment indicated on Contract Documents.
  2. Performance and design criteria if Contractor has 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. Use designations for products indicated on Contract Documents.
  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 MANUALS

- 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 and drawing or schedule designation or identifier where applicable.
- 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.

## 2.6 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

- 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 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 and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
  - 1. Standard 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 video recording, 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.
- H. 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.

### 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 a complete set of emergency information indicating procedures for use by emergency personnel and by 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 Section 01 7839 "Project Record Documents."
- G. Comply with Section 01 7700 "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823

## SECTION 01 7839 - PROJECT RECORD DOCUMENTS

### 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 project record documents, including the following:
  - 1. Record Drawings.
  - 2. Record Specifications.
  - 3. Record Product Data.
  - 4. Miscellaneous record submittals.
- B. Related Requirements:
  - 1. Section 01 7300 "Execution" for final property survey.
  - 2. Section 01 7700 "Closeout Procedures" for general closeout procedures.
  - 3. Section 01 7823 "Operation and Maintenance Data" for operation and maintenance manual requirements.

#### 1.3 CLOSEOUT SUBMITTALS

- A. Record Drawings: Comply with the following:
  - 1. Number of Copies: Submit one set of marked-up record prints.
  - 2. Number of Copies: Submit copies of record Drawings as follows:
    - a. Initial Submittal:
      - 1) Submit PDF electronic files of scanned record prints and one of file prints.
      - 2) Architect will indicate whether general scope of changes, additional information recorded, and quality of drafting are acceptable.
    - b. Final Submittal:
      - 1) Submit three paper-copy set(s) of marked-up record prints.
      - 2) Submit PDF electronic files of scanned record prints and three set(s) of prints.
      - 3) Print each drawing, whether or not changes and additional information were recorded.

- c. Final Submittal:
  - 1) Submit one paper-copy set(s) of marked-up record prints.
  - 2) Submit record digital data files and three set(s) of record digital data file plots.
  - 3) Plot each drawing file, whether or not changes and additional information were recorded.
- B. Record Specifications: Submit annotated PDF electronic files of Project's Specifications, including addenda and contract modifications.
- C. Record Product Data: Submit annotated PDF electronic files and directories of each submittal.
  - 1. Where record Product Data are required as part of operation and maintenance manuals, submit duplicate marked-up Product Data as a component of manual.
- D. Miscellaneous Record Submittals: See other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit annotated PDF electronic files and directories of each submittal.
- E. Reports: Submit written report weekly indicating items incorporated into project record documents concurrent with progress of the Work, including revisions, concealed conditions, field changes, product selections, and other notations incorporated.

## PART 2 - PRODUCTS

### 2.1 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
  - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
    - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
    - b. Accurately record information in an acceptable drawing technique.
    - c. Record data as soon as possible after obtaining it.
    - d. Record and check the markup before enclosing concealed installations.
    - e. Cross-reference record prints to corresponding archive photographic documentation.
  - 2. Content: Types of items requiring marking include, but are not limited to, the following:
    - a. Dimensional changes to Drawings.
    - b. Revisions to details shown on Drawings.

- c. Depths of foundations below first floor.
    - d. Locations and depths of underground utilities.
    - e. Revisions to routing of piping and conduits.
    - f. Revisions to electrical circuitry.
    - g. Actual equipment locations.
    - h. Duct size and routing.
    - i. Locations of concealed internal utilities.
    - j. Changes made by Change Order or Construction Change Directive.
    - k. Changes made following Architect's written orders.
    - l. Details not on the original Contract Drawings.
    - m. Field records for variable and concealed conditions.
    - n. Record information on the Work that is shown only schematically.
  3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
  4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
  5. Mark important additional information that was either shown schematically or omitted from original Drawings.
  6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
1. Format: Annotated PDF electronic file with comment function enabled.
  2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
  3. Refer instances of uncertainty to Architect for resolution.
  4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
    - a. See Division 01 Section "Submittal Procedures" for requirements related to use of Architect's digital data files.
    - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.
1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
  2. Consult Architect for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.

- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
  - 1. Format: Annotated PDF electronic file with comment function enabled.
  - 2. Identification: As follows:
    - a. Project name.
    - b. Date.
    - c. Designation "PROJECT RECORD DRAWINGS."
    - d. Name of Architect.
    - e. Name of Contractor.

## 2.2 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
  - 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
  - 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
  - 5. Note related Change Orders, record Product Data, and record Drawings where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

## 2.3 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
  - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
  - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
  - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.
  - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

## 2.4 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
  - 1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

## PART 3 - EXECUTION

### 3.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Maintenance of Record Documents and Samples: Store record documents and Samples in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Architect's reference during normal working hours.

END OF SECTION 01 7839



## SECTION 01 7900 - DEMONSTRATION AND TRAINING

### 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 instructing Owner's personnel, including the following:
  - 1. Demonstration of operation of systems, subsystems, and equipment.
  - 2. Training in operation and maintenance of systems, subsystems, and equipment.
  - 3. Demonstration and training video recordings.

#### 1.3 INFORMATIONAL SUBMITTALS

- A. Instruction Program: Submit outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
  - 1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.
- B. Qualification Data: For facilitator.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Demonstration and Training Video Recordings: Submit two copies within seven days of end of each training module.
  - 1. Identification: On each copy, provide an applied label with the following information:
    - a. Name of Project.

- b. Name and address of videographer.
  - c. Name of Architect.
  - d. Name of Construction Manager.
  - e. Name of Contractor.
  - f. Date of video recording.
2. Transcript: Prepared in PDF electronic format. Include a cover sheet with same label information as the corresponding video recording and a table of contents with links to corresponding training components. Include name of Project and date of video recording on each page.
3. At completion of training, submit complete training manual(s) for Owner's use in PDF electronic file format on compact disc.

## 1.5 QUALITY ASSURANCE

- A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.
- B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Section "01 4000 Quality Requirements," experienced in operation and maintenance procedures and training.
- C. Videographer Qualifications: A professional videographer who is experienced photographing demonstration and training events similar to those required.
- D. Preinstruction Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." Review methods and procedures related to demonstration and training including, but not limited to, the following:
  1. Inspect and discuss locations and other facilities required for instruction.
  2. Review and finalize instruction schedule and verify availability of educational materials, instructors' personnel, audiovisual equipment, and facilities needed to avoid delays.
  3. Review required content of instruction.
  4. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.

## 1.6 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.

- C. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

## PART 2 - PRODUCTS

### 2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
  - 1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    - a. System, subsystem, and equipment descriptions.
    - b. Performance and design criteria if Contractor is delegated design responsibility.
    - c. Operating standards.
    - d. Regulatory requirements.
    - e. Equipment function.
    - f. Operating characteristics.
    - g. Limiting conditions.
    - h. Performance curves.
  - 2. Documentation: Review the following items in detail:
    - a. Emergency manuals.
    - b. Operations manuals.
    - c. Maintenance manuals.
    - d. Project record documents.
    - e. Identification systems.
    - f. Warranties and bonds.
    - g. Maintenance service agreements and similar continuing commitments.
  - 3. Emergencies: Include the following, as applicable:
    - a. Instructions on meaning of warnings, trouble indications, and error messages.
    - b. Instructions on stopping.
    - c. Shutdown instructions for each type of emergency.
    - d. Operating instructions for conditions outside of normal operating limits.
    - e. Sequences for electric or electronic systems.
    - f. Special operating instructions and procedures.
  - 4. Operations: Include the following, as applicable:

- a. Startup procedures.
  - b. Equipment or system break-in procedures.
  - c. Routine and normal operating instructions.
  - d. Regulation and control procedures.
  - e. Control sequences.
  - f. Safety procedures.
  - g. Instructions on stopping.
  - h. Normal shutdown instructions.
  - i. Operating procedures for emergencies.
  - j. Operating procedures for system, subsystem, or equipment failure.
  - k. Seasonal and weekend operating instructions.
  - l. Required sequences for electric or electronic systems.
  - m. Special operating instructions and procedures.
5. Adjustments: Include the following:
  - a. Alignments.
  - b. Checking adjustments.
  - c. Noise and vibration adjustments.
  - d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
  - a. Diagnostic instructions.
  - b. Test and inspection procedures.
7. Maintenance: Include the following:
  - a. Inspection procedures.
  - b. Types of cleaning agents to be used and methods of cleaning.
  - c. List of cleaning agents and methods of cleaning detrimental to product.
  - d. Procedures for routine cleaning
  - e. Procedures for preventive maintenance.
  - f. Procedures for routine maintenance.
  - g. Instruction on use of special tools.
8. Repairs: Include the following:
  - a. Diagnosis instructions.
  - b. Repair instructions.
  - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
  - d. Instructions for identifying parts and components.
  - e. Review of spare parts needed for operation and maintenance.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 "Operation and Maintenance Data."
- B. Set up instructional equipment at instruction location.

### 3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
  - 1. Owner will furnish an instructor to describe Owner's operational philosophy.
  - 2. Owner will furnish Contractor with names and positions of participants.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.
  - 1. Schedule training with Owner, through Architect, with at least seven days' advance notice.
- D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.
- E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral or a demonstration performance-based test.
- F. Cleanup: Collect used and leftover educational materials and give to Owner. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

### 3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

- A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
  - 1. At beginning of each training module, record each chart containing learning objective and lesson outline.

- B. Video: Provide minimum 640 x 480 video resolution converted to format file type acceptable to Owner, on electronic media.
  - 1. Electronic Media: Read-only format compact disc acceptable to Owner, with commercial-grade graphic label.
  - 2. File Hierarchy: Organize folder structure and file locations according to project manual table of contents. Provide complete screen-based menu.
  - 3. File Names: Utilize file names based upon name of equipment generally described in video segment, as identified in Project specifications.
  - 4. Contractor and Installer Contact File: Using appropriate software, create a file for inclusion on the Equipment Demonstration and Training DVD that describes the following for each Contractor involved on the Project, arranged according to Project table of contents:
    - a. Name of Contractor/Installer.
    - b. Business address.
    - c. Business phone number.
    - d. Point of contact.
    - e. E-mail address.
- C. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to adequately cover area of demonstration and training. Display continuous running time.
  - 1. Film training session(s) in segments not to exceed 15 minutes.
    - a. Produce segments to present a single significant piece of equipment per segment.
    - b. Organize segments with multiple pieces of equipment to follow order of Project Manual table of contents.
    - c. Where a training session on a particular piece of equipment exceeds 15 minutes, stop filming and pause training session. Begin training session again upon commencement of new filming segment.
- D. Light Levels: Verify light levels are adequate to properly light equipment. Verify equipment markings are clearly visible prior to recording.
  - 1. Furnish additional portable lighting as required.
- E. Narration: Describe scenes on video recording by audio narration by microphone while or dubbing audio narration off-site after video recording is recorded. Include description of items being viewed.
- F. Transcript: Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
- G. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01 7900

## SECTION 01 9113 - GENERAL COMMISSIONING REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.
- B. OPR and BoD documentation are included by reference for information only.

#### 1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
  - 1. Division 23 sections for commissioning process activities for HVAC systems, assemblies, equipment, and components.

#### 1.3 DEFINITIONS

- A. BoD: Basis of Design. A document that records concepts, calculations, decisions, and product selections used to meet the OPR and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- B. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- C. CxA: Commissioning Authority.
- D. OPR: Owner's Project Requirements. A document that details the functional requirements of a project and the expectations of how it will be used and operated. These include Project goals, measurable performance criteria, cost considerations, benchmarks, success criteria, and supporting information.
- E. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

#### 1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractors: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process

through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate by the CxA.

B. Members Appointed by Owner:

1. CxA: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Owner will engage the CxA under a separate contract.
2. Representatives of the facility user and operation and maintenance personnel.
3. Architect and engineering design professionals.

1.5 OWNER'S RESPONSIBILITIES

- A. Provide the OPR documentation to the CxA and Contractor for information and use.
- B. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.
- C. Provide the BoD documentation, prepared by Architect and approved by Owner, to the CxA and Contractor for use in developing the commissioning plan, systems manual, and operation and maintenance training plan.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
  1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
  2. Cooperate with the CxA for resolution of issues recorded in the Issues Log.
  3. Attend commissioning team meetings held on a weekly basis.
  4. Integrate and coordinate commissioning process activities with construction schedule.
  5. Review and accept construction checklists provided by the CxA.
  6. Complete electronic construction checklists as Work is completed and provide to the Commissioning Authority on a weekly basis.
  7. Review and accept commissioning process test procedures provided by the Commissioning Authority.
  8. Complete commissioning process test procedures.

1.7 CxA'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.



- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.
- E. Verify the execution of commissioning process activities using random sampling. The sampling rate may vary from 1 to 100 percent. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with the OPR. When a random sample does not meet the requirement, the CxA will report the failure in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 9113

## SECTION 02 4118 - SELECTIVE STRUCTURE DEMOLITION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Demolition and removal of selected portions of building or structure.
  - 2. Salvage of existing items to be reused or recycled.

- B. Related Requirements:

- 1. Section 01 1000 "Summary" for restrictions on the use of the premises, Owner-occupancy requirements, and phasing requirements.
  - 2. Section 01 7300 "Execution" for cutting and patching procedures.
  - 3. Section 02 4119 "Site Demolition" for selective demolition of site elements and landscaping.
  - 4. Section 31 1000 "Site Clearing" for site clearing and removal of above- and below-grade improvements.

#### 1.3 DEFINITIONS

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

#### 1.4 MATERIALS OWNERSHIP

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

## 1.5 PREINSTALLATION MEETINGS

- A. Predemolition Conference: Conduct conference at Project site.
  - 1. Inspect and discuss condition of construction to be selectively demolished.
  - 2. Review structural load limitations of existing structure.
  - 3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
  - 4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
  - 5. Review areas where existing construction is to remain and requires protection.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For refrigerant recovery technician.
- B. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property , for environmental protection and for dust control. Indicate proposed locations and construction of barriers.
- C. Schedule of Selective Demolition Activities: Indicate the following:
  - 1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
  - 2. Interruption of utility services. Indicate how long utility services will be interrupted.
  - 3. Coordination for shutoff, capping, and continuation of utility services.
  - 4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
- D. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
- E. Predemolition Photographs or Video: Submit before Work begins.
- F. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.
- G. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

## 1.7 CLOSEOUT SUBMITTALS

- A. Inventory: Submit a list of items that have been removed and salvaged.

- B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

## 1.8 QUALITY ASSURANCE

- A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

## 1.9 FIELD CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Standards: Comply with ANSI/ASSE A10.6 and NFPA 241.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Verify that utilities have been disconnected and capped before starting selective demolition operations.
- B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- C. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.
- D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.
- E. Engage a professional engineer to perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
  - 1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
- F. Survey of Existing Conditions: Record existing conditions by use of measured drawings or preconstruction photographs.
  - 1. Comply with requirements specified in Section 01 3233 "Photographic Documentation."
  - 2. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.
  - 3. Before selective demolition or removal of existing building elements that will be reproduced or duplicated in final Work, make permanent record of measurements, materials, and construction details required to make exact reproduction.

#### 3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

- A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.
  - 1. Comply with requirements for existing services/systems interruptions specified in Section 01 1000 "Summary."
- B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.

1. Arrange to shut off indicated utilities with utility companies.
  2. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
  3. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
    - a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
    - b. Equipment to Be Removed: Disconnect and cap services and remove equipment.
    - c. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

### 3.3 PREPARATION

- A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Comply with requirements for access and protection specified in Division 01 Section "Temporary Facilities and Controls."
- B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.
1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.
  2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.
  3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.
  4. Cover and protect furniture, furnishings, and equipment that have not been removed.
  5. Comply with requirements for temporary enclosures, dust control, heating, and cooling specified in Section 01 5000 "Temporary Facilities and Controls."
- C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
1. Strengthen or add new supports when required during progress of selective demolition.

### 3.4 SELECTIVE DEMOLITION, GENERAL

- A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
  2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
  3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
  4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
  5. Maintain adequate ventilation when using cutting torches.
  6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
  7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
  8. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
  9. Dispose of demolished items and materials promptly.
- B. Removed and Salvaged Items:
1. Clean salvaged items.
  2. Pack or crate items after cleaning. Identify contents of containers.
  3. Store items in a secure area until delivery to Owner.
  4. Transport items to Owner's storage area designated by Owner.
  5. Protect items from damage during transport and storage.
- C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse.
  2. Pack or crate items after cleaning and repairing. Identify contents of containers.
  3. Protect items from damage during transport and storage.
  4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.
- D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and reinstalled in their original locations after selective demolition operations are complete.

### 3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

- A. Concrete: Demolish in small sections. Using power-driven saw, cut concrete to a depth of at least 3/4 inch at junctures with construction to remain. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete. Neatly trim openings to dimensions indicated.
- B. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.
- C. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.
- D. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.
- E. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI's "Recommended Work Practices for the Removal of Resilient Floor Coverings." Do not use methods requiring solvent-based adhesive strippers.
- F. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight. See Division 07 Section "Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for new roofing requirements.
  - 1. Remove existing roof membrane, flashings, copings, and roof accessories as indicated in Division 07 Section "Preparation for Re-Roofing".

### 3.6 DISPOSAL OF DEMOLISHED MATERIALS

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



### 3.7 CLEANING

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

### 3.8 SELECTIVE DEMOLITION SCHEDULE

- A. Existing Construction to Be Removed: Items and construction as indicated on drawings.
- B. Existing Items to Be Removed and Salvaged: Items and construction as indicated on drawings and as directed by owner. Items include, but are not limited to, the following:
  - 1. Fire Alarm Equipment as follows:
    - a. Keep existing fire panel for parts.
    - b. Salvage smoke heads for district stock.
    - c. Salvage door magnets for district stock.
  - 2. Access control system as follows:
    - a. Salvage existing readers and strikes for district stock.
  - 3. Security system as follows:
    - a. Salvage existing security panel for district stock.
  - 4. CCTV as follows:
    - a. Salvage all existing CCTV for district stock.
- C. Existing Items to Be Removed and Reinstalled: Items and construction as indicated on drawings and as directed by owner.
  - 1. Access control system as follows:
    - a. Reinstall main panel.
    - b. Reuse existing power supplies at Contractor's option.
- D. Existing Items to Remain: Items and construction as indicated on drawings.

END OF SECTION 02 4118

## SECTION 03 3000 - CAST-IN-PLACE CONCRETE

### 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 specifies cast-in place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
  - 1. Footings.
  - 2. Slabs-on-grade.
  - 3. Concrete toppings over Geofoam fill.

#### 1.3 DEFINITIONS

- A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: fly ash and other pozzolans, ground granulated blast-furnace slag, and silica fume; subject to compliance with requirements.
- B. Architectural Concrete: Formed concrete that is exposed to view on surfaces of completed structure or building and that requires special concrete materials, formwork, placement, or finishes to obtain specified high quality architectural appearance. All exposed concrete shall be high quality architectural concrete.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
  - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

- D. Formwork Shop Drawings: Prepared by or under the supervision of a qualified professional engineer detailing fabrication, assembly, and support of formwork.
  - 1. Shoring and Reshoring: Indicate proposed schedule and sequence of stripping formwork, shoring removal, and installing and removing reshoring.
  - 2. High Quality Architectural Concrete Formwork Shop Drawings: Show formwork construction including form-facing joints, construction and contraction joints, form joint-sealant details, form tie locations and patterns, inserts and embedments, cutouts, cleanout panels, and other items that visually affect cast-in-place architectural concrete.
- E. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
  - 1. Location of construction joints is subject to approval of the Architect.
- F. Samples: For vapor retarder.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
  - 1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- C. Material Certificates: For each of the following, signed by manufacturers:
  - 1. Cementitious materials.
  - 2. Admixtures.
  - 3. Form materials and form-release agents.
  - 4. Steel reinforcement and accessories.
  - 5. Floor and slab treatments.
  - 6. Bonding agents.
  - 7. Adhesives.
  - 8. Semirigid joint filler.
  - 9. Joint-filler strips.
  - 10. Repair materials.
  - 11. Steel producer's certificates of mill analysis including physical and chemical analysis of reinforcing steel.
- D. Floor surface flatness and levelness measurements to determine compliance with specified tolerances.
- E. Field quality-control test and inspection reports.
- F. Minutes of preinstallation conference.

## 1.6 QUALITY ASSURANCE

- A. **Installer Qualifications:** A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician. Installer is to have completed concrete Work with a minimum of 10 year record of successful in-service performance and similar in material, design, and extent to that indicated for this Project.
- B. **Manufacturer Qualifications:** A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
  - 1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. **Source Limitations:** Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from one source, and obtain admixtures through one source from a single manufacturer.
- D. **ACI Publications:** Comply with the following unless modified by requirements in the Contract Documents:
  - 1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
  - 2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
  - 3. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice."
- E. **Mockups:** Cast concrete slab-on-grade and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.
  - 1. Build panel approximately 200 sq. ft. for slab-on-grade and 100 sq. ft. for formed surface in the location indicated or, if not indicated, as directed by Architect. For any exposed concrete walls, configure the Class A tolerance wall to include one 90 degree outside chamfered corner, one cold construction joint, one form joint, and other features as may be applicable.
  - 2. Approved panels may become part of the completed Work if undisturbed at time of Substantial Completion.
  - 3. Demolish mockup and remove from site when directed by Architect.
- F. **Preinstallation Conference:** Conduct conference at Project site.
  - 1. At least 20 days prior to submitting design mixtures, conduct a meeting to review concrete design mixture and examine procedures for ensuring quality of concrete materials. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials inspection, testing, and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
    - a. Contractor's superintendent.
    - b. Independent testing agency responsible for concrete design mixtures.
    - c. Agency responsible for concrete design mixes.

- d. Agency responsible for field quality control.
  - e. Ready-mix concrete manufacturer.
  - f. Concrete subcontractor.
- 2. Review special inspection and testing and inspecting agency procedures for field quality control, concrete finishes and finishing, cold- and hot-weather concreting procedures, curing procedures, construction contraction and isolation joints, and joint-filler strips, anchor rod and anchorage device installation tolerances, steel reinforcement installation, floor and slab flatness and levelness measurement, concrete repair procedures, and concrete protection.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

## 1.8 GUARANTEE

- A. Special Guarantee: On form approved by Architect, without monetary limitation, in which manufacturer agrees to promptly repair or replace all components of concrete that fails in materials or workmanship, including material and labor, within specified guarantee period.
  - 1. Failures include pitting, spalling, cracking, honeycombing, surface color and texture irregularities, air bubbles, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Immediately repair or replace concrete and place in satisfactory condition in every particular, any guaranteed work upon written notice from the Project Manager or Architect and make good all damage to the buildings and grounds caused by said work, without cost to the Owner.
  - 2. Warranty Period: 2 years from date of Substantial Completion.
- B. Guarantee for New Replacement Work: Provide similar, new 2-year guarantee from date of completion of replacement work.

## PART 2 - PRODUCTS

### 2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Provide form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - 1. Forms for Smooth-Formed Finished Concrete: For concrete designated to receive direct finishes such as carpet, tile, EIFS skim coats, etc., provide
    - a. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as one of the following:

- 1) High-density overlay undamaged plywood, Class 1 or better; mill-release agent treated and edge sealed, 3/4-inch thick.
  - 2) B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
2. Forms for Smooth-Formed Architectural Finished Exposed Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
  - a. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as one of the following:
    - 1) Medium-density overlay, Class 1 or better; mill-release agent treated and edge sealed.
    - 2) B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.
  - B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
  - C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
  - D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
  - E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
  - F. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
    1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
  - G. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
    1. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
    2. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

## 2.2 ARCHITECTURAL CONCRETE

- A. High Quality Architectural Concrete: Quality of all exposed-to-view concrete and all concrete surfaces to receive waterproofing is of primary importance. Quality of all exposed-to-view concrete is to be consistent in appearance and is to have no less than the following characteristics:
  1. Proper and consistent alignment of form panels and form ties.

2. Absence of staining from form leakage.
3. Absence of honeycomb or excessive segregation due to improper vibration or form leakage.
4. Correct placement of rustication or other detail treatment as shown on drawings.
5. Truly square and plumb corners unless clearly directed otherwise.
6. Absence of markings from formwork (i.e. use MDF or plastic forms.)
7. Surfaces to receive waterproofing or thru-wall flashings are free of coatings, form release agents, sealers, curing agents, treatments, and similar materials, unless written prior approval of the products used is obtained from the specified waterproofing or thru-wall flashing manufacturer.

## 2.3 GEOFOAM

- A. Rigid Cellular Polystyrene Geofoam: ASTM D 6817, Type EPS 39, 2.40-lb/cu. ft. density, 15-psi compressive strength at 1 percent deformation; 40-psi compressive strength at 10 percent deformation.
- B. Connectors: Geofoam manufacturer's multibarbed, galvanized-steel sheet connectors.

## 2.4 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.
- C. Plain-Steel Wire: ASTM A 82, as drawn.

## 2.5 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut bars true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
  1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
  2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

## 2.6 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I/II, gray. Supplement with the following:
  - a. Fly Ash: ASTM C 618, Class F or C.
  - b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
  1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
  2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
  3. For exposed surfaces, do not use fine or coarse aggregates which may cause stains on concrete surfaces or that contain substances that cause spalling.
  4. Do not use aggregates containing soluble salts or other substances such as iron sulphides, pyrite, marcasite, or ochre which can cause stains on concrete surfaces.
- C. Water: ASTM C 94/C 94M and potable.

## 2.7 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
  1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
  2. Water-Reducing Accelerating Admixture: ASTM C 494/C 494M, Type E.
  3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
  4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
  5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
  6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
- C. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C 494/C 494M, Type C.
  1. Products:
    - a. Euclid Chemical Company (The); Eucon CIA.
    - b. Grace Construction Products, W. R. Grace & Co.; DCI.
    - c. Master Builders, Inc.; Rheocrete CNI.
    - d. Sika Corporation; Sika CNI.



## 2.8 VAPOR RETARDERS

- A. Sheet Vapor Retarder: ASTM E 1745, Class A, except with maximum perm rating of 0.012. Include manufacturer's recommended adhesive or pressure-sensitive tape.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Carlisle Coatings & Waterproofing, Inc.; Blackline 400.
  - b. Reef Industries, Inc.; Griffolyn 15 mil Green.
  - c. Stego Industries, LLC; Stego Wrap 15 mil Class A.

## 2.9 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or silicate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
1. Products: Subject to compliance with requirements, provide one of the following:
- a. Conspec by Dayton Superior; Intraseal.
  - b. Curecrete Distribution Inc.; Ashford Formula.
  - c. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
  - d. Euclid Chemical Company (The), an RPM company; Euco Diamond Hard.
  - e. Symons by Dayton Superior; Buff Hard.
  - f. US SPEC, Division of US Mix Products Company; US SPEC Industraseal.

## 2.10 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
1. Products:
- a. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Aquafilm.
  - b. Euclid Chemical Company (The); Eucobar.
  - c. L&M Construction Chemicals, Inc.; E-Con.
  - d. MBT Protection and Repair, Div. of ChemRex; Confilm.
  - e. Metalcrete Industries; Waterhold.
- B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- C. Water: Potable.
- D. Liquid Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class A, moisture loss not more than 0.55 kg/sq. meter when applied at 200 sq. ft./gal.
1. Products:

- a. Anti-Hydro International, Inc.; A-H 3 Way Sealer.
- b. Burke by Edoco; Spartan-Cote.
- c. Conspec Marketing & Manufacturing Co., Inc., a Dayton Superior Company; Conspec #1.
- d. Euclid Chemical Company (The); Eucocure.
- e. L&M Construction Chemicals, Inc.; L&M Cure R.
- f. MBT Protection and Repair, Div. of ChemRex; Masterkure.
- g. W.R. Meadows, Inc.; CS-309.
- h. Metalcrete Industries; Seal N Kure.
- i. Sonneborn, Div. of ChemRex; Kure-N-Seal

## 2.11 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber. Construct isolation joints in slabs-on-grade at points of contact between slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations as indicated
- B. Bonding Agent: ASTM C 1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Reglets: Fabricate reglets of not less than 0.0217-inch- thick, galvanized steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.
- D. Dovetail Anchor Slots: Hot-dip galvanized steel sheet, not less than 0.0336 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

## 2.12 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
  1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
  2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
  3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
  4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.
- B. Crack Repair Routing and Sealing Products:
  1. Urethane, Immersible, S, NS, 35, T, NT, I: Immersible, single-component, nonsag, plus 35 percent and minus 35 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 35, Uses T, NT, and I.

- a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
  - 1) Sika Corporation; Joint Sealants; Sikaflex 1a.
- 2. Urethane, M, NS, 25, T, NT: Multicomponent, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type M, Grade NS, Class 25, Uses T and NT.
  - a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to the following:
    - 1) Sika Corporation; Joint Sealants; Sikaflex 2c NS EZ Mix.

## 2.13 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
  - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
  - 2. Do not use the same testing agency for field quality control testing.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
  - 1. Combined Fly Ash or Pozzolan and Ground Granulated Blast-Furnace Slag: 20 percent portland cement minimum, with fly ash or pozzolan not exceeding 15 percent.
- C. Admixtures: Use admixtures according to manufacturer's written instructions.
  - 1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
  - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
  - 3. Use water-reducing admixture in pumped concrete, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.
  - 4. Use accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F.
  - 5. Use high-range water-reducing admixture in pumped concrete, architectural concrete, concrete required to be watertight, and concrete with water-cement ratios below 0.50.
  - 6. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content with a tolerance of plus or minus 1-1/2 percent within the following limits:
    - a. Concrete structures and slabs exposed to freezing and thawing, deicer chemicals, or hydraulic pressure: 6.0 percent for 3/4-inch maximum aggregate.
    - b. Other concrete not exposed to freezing, thawing, or hydraulic pressure, or to receive a surface hardener: 2 to 3 percent air.

- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when warranted by characteristics of materials, job conditions, weather, test results, or other circumstances. Submit laboratory test data for revised mix design and strength results to Architect and obtain Architect's acceptance before using in Work.
1. Laboratory Trial Batches: When laboratory trial batches are used to select concrete proportions, prepare test specimens as specified in ACI 301 and in accordance with ASTM C 192 and conduct strength tests in accordance with ASTM C 39.
  2. Field Experience Method: When field experience methods are used to select concrete proportions, establish proportions as specified in ACI 301.
  3. If suitable data from field experience or laboratory trial batches cannot be obtained, concrete proportions may be established by use of the water-cement ratio limits table and the limiting restrictions of ACI 301.
  4. Strength data for establishing standard deviation will be considered suitable if the concrete production facility has certified records consisting of at least 30 consecutive tests in one group or the statistical average for 2 groups totaling 30 or more tests, representing similar materials and project conditions.
  5. Standard Deviation: If standard deviation exceeds 600 psi or if no suitable records are available, select proportions to produce an average strength of at least 1200 psi greater than the required compressive strength of concrete.
  6. After sufficient experience and test data become available from the job, using ACI 214 methods of evaluation, the standard deviation may be reduced when the probable frequency of tests more than 500 psi below required compressive strength will not exceed 1 in 100, and that the probable frequency of an average of 3 consecutive tests below required compressive strength will not exceed 1 in 100.

## 2.14 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. General: Submit written reports to Architect of each proposed mix for each class of concrete at least 15 days prior to start of Work. Do not begin concrete production until proposed mix designs have been reviewed by Architect.
- B. Footings: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 3000 psi at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.55.
  3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
  4. Air Content: At exterior footings provide 5 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
- C. Foundation Walls and Planter Walls: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi at 28 days.
  2. Maximum Water-Cementitious Materials Ratio: 0.55.
  3. Slump Limit: 4 inches or 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture.
  4. Air Content: At exterior foundation walls provide 5 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

D. Slabs-on-Grade: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: At 28 days, 4000 psi at interior slabs 5000 psi at exterior slabs and flat work.
2. Minimum Cementitious Materials Content: 611 lb/cu. yd.
3. Slump Limit: 4 inches, maximum.
4. Air Content: At exterior provide 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.
5. Air Content: Do not allow air content of troweled interior finished floors to exceed 3 percent.
6. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 3 lb/cu. yd.

E. Concrete Toppings on Geofoam Fill: Proportion normal-weight concrete mixture as follows:

1. Minimum Compressive Strength: 4000 psi at 28 days.
2. Minimum Cementitious Materials Content: 470 lb/cu. yd.
3. Slump Limit: 4 inches, plus or minus 1 inch.
4. Air Content: Do not allow air content of troweled finished interior toppings to exceed 3 percent.
5. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than amount indicated.

2.15 FABRICATING REINFORCEMENT

- A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.16 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
2. Include at least the following information on each batch ticket:
  - a. Name of ready-mix batch plant.
  - b. Serial number of ticket.
  - c. Date and number of truck.
  - d. Name of Contractor.
  - e. Specific designation of job (name and location).
  - f. Volume of concrete (number of cubic yards).
  - g. Time batch was dispensed to truck.
  - h. Reading of revolution counter at first addition of water.
  - i. Signature or initials of ready-mix representative.
  - j. Type and brand of cement.
  - k. Amount of cement (can be indicated by weight or quantity).

- l. Total water content by producer (can be indicated by weight or quantity).
- m. Water added by receiver of concrete and his initials (can be indicated by weight or quantity).
- n. Admixtures and amount of same.
- o. Maximum size of aggregate.
- p. Weights of fine and coarse aggregates.
- q. Indication that all ingredients are as previously certified or approved.

### PART 3 - EXECUTION

#### 3.1 COORDINATION

- A. Coordinate the installation of joint materials and other related materials with placement of forms and reinforcing steel.

#### 3.2 PREPARATION

- A. Ensure that all silt, loose rock, and deleterious material has been removed from the building area prior to concrete pouring. Evaluate site prior to bidding to determine if any additional topsoil removal may be required. Do not use this material as fill.

#### 3.3 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads. Use camber in the formwork as required for anticipated deflections.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Construct forms to sizes, shapes, lines, and dimensions shown and to obtain accurate alignment, location, grades, level, and plumb work in finished structures. Use selected materials to obtain required finishes.
- D. Limit concrete surface irregularities, designated by ACI 347R as abrupt or gradual, as follows:
  - 1. Class A, 1/8 inch for smooth-formed finished surfaces and high quality architectural surfaces including surfaces exposed to view and surfaces to receive waterproofing, carpeting, or vinyl tiling. Comply with ACI 303.1 limits on form-facing panel deflection.
  - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
- F. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, recesses, and the like, for easy removal.
  2. Do not use rust-stained steel form-facing material.
  3. Coat steel forms with a nonstaining, rust-preventative material.
- G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- I. At construction joints, overlap forms over hardened concrete at least 6 inches.
- J. Chamfer exterior corners and edges of permanently exposed concrete.
- K. Form openings, chases, offsets, sinkages, keyways, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items. Accurately place and securely support items built into forms.
- L. Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- M. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- N. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-release agent, according to manufacturer's written instructions, before placing reinforcement.
1. Form coatings: Coat forms prior to placement of reinforcing steel. Do not allow excess form coating material to accumulate in forms or come into contact with surfaces which will be bonded to fresh concrete. Apply according to manufacturer's instructions.
- O. Forms for Slabs: Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and contours in finished surfaces. Provide and secure units to support screed strips using strike-off templates or compacting-type screeds.

### 3.4 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."
  2. Install dovetail anchor slots in concrete structures as indicated.
  3. Place all sleeves, inserts, anchors and embedded items required for adjoining work, or for its support, prior to concreting.

### 3.5 REMOVING AND REUSING FORMS

- A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, if concrete is hard enough to not be damaged by form-removal operations and curing and protection operations are maintained.
  - 1. Leave formwork for beam soffits, joists, slabs, and other structural elements that supports weight of concrete in place until concrete has achieved 100 percent of its 28-day design compressive strength or for 28 days, whichever is longer.
    - a. Determining numbers of cylinders, testing dates, and costs associated with field-cured cylinders.
  - 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores. Do not remove form-facing material less than 4 days after placement.
- B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

### 3.6 SHORES AND RESHORES

- A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.
  - 1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.
- B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.
- C. Keep reshores in place a minimum of 28 days after placing upper tier, or longer, if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

### 3.7 VAPOR RETARDERS

- A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.
  - 1. Lap joints 6 inches and seal with manufacturer's recommended tape.



### 3.8 GEOFOAM FILL

- A. Place a leveling course of sand, 2 inches thick, over subgrade. Finish leveling course to a tolerance of 1/2 inch when tested with a 10-foot straightedge.
  - 1. Place leveling course on subgrades free of mud, frost, snow, or ice.
- B. Install geofoam blocks in layers with abutting edges and ends and with the long dimension of each block at right angles to blocks in each subsequent layer. Offset joints of blocks in successive layers.
- C. Install geofoam connectors at each layer of geofoam to resist horizontal displacement according to geofoam manufacturer's written instructions.

### 3.9 CRACK REPAIR ROUTING

- A. Install crack repair urethane to requirements of Section 07 9200 "Joint Sealants," including joint preparation, installation and field quality control, cleaning off excess sealants, and protecting of installed joint sealants during and after curing..

### 3.10 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
  - 1. Do not tack weld reinforcing bars.
  - 2. Do not bend reinforcing steel after embedding in hardened concrete, unless authorized by Owner.
  - 3. In the case of fabricating errors, do not rebend or straighten reinforcing steel.
  - 4. Locate reinforcing splices at points of minimum stress.
  - 5. Reinforcement with any of the following defects will not be permitted in the work:
    - a. Bar lengths, depths, and bends exceeding specified fabrication limits.
    - b. Bends or kinks not indicated on drawings or final shop drawings.
    - c. Bars with reduced cross-section due to excessive rusting or other cause.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
- D. Secure reinforcement bars with wire ties at all points of intersection unless the spacing is less than 12 inches in each direction, in which case tie alternate points of intersection Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

- E. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

### 3.11 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
  - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
  - 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
  - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
  - 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
  - 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
  - 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
  - 1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
  - 2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
  - 3. If joint pattern is not shown, provide joints not exceeding 15 feet in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third bays). Show on shop drawings for architect's approval.
  - 4. Joint fillers and sealants are specified in Division 07 Section "Joint Sealants."
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
  - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 Section "Joint Sealants," are indicated.
  3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

### 3.12 CONCRETE PLACEMENT

- A. If concrete of a concrete delivery truck is rejected for any reason, do not allow truck on-site for a minimum of 12 hours after moment of rejection.
- B. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed. Notify other trades to permit installation of their work.
- C. Preparation of Subgrade for Slabs on Grade: Keep subgrade moist but do not allow standing water, mud or soft spots. If temperature where concrete is to be placed is below 50EF, enclose and heat to maintain temperature above 50EF long enough to remove frost from subgrade.
- D. Comply with ACI 304, "Guide for Measuring, Mixing, Transporting, and Placing Concrete," and as specified.
- E. Do not allow time between charging of materials in the mixing drum and placement on site to exceed 90 minutes (60 minutes for air-entrained concrete), less for higher temperatures.
- F. Use conveying equipment that conforms to ASTM C 94.
- G. Handle concrete from mixer to place of final deposit as rapidly as practicable.
- H. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 and the following. Account for all water added to the concrete mix.
1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.
  2. Do not add any water to ready-mix concrete drum unless the following conditions are satisfied:
    - a. Water is added only while the concrete is mixing in the drum.
    - b. Mixing truck is equipped with a revolution counter and a working water meter.
    - c. Delivery ticket provides all information required in this Section so that the total amount of water added to the mix can be determined.
    - d. Provide slurry test and compression tests for all concrete after water is added at site.
- I. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of

weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth no deeper than 24 inches and to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
  2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301. Internal vibrators shall have a minimum frequency of 8000 vibrations per minute and sufficient amplitude to consolidate the concrete effectively.
  3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
  4. If a section cannot be placed continuously, locate construction joints as approved a maximum of 30 foot on center.
  5. Do not allow concrete to free fall over 4 feet.
  6. Deposit concrete as near as possible to its final position to avoid segregation due to rehandling or flowing.
  7. Clean and dampen hardened concrete surfaces to receive fresh concrete.
- J. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
  2. Maintain reinforcement in position on chairs during concrete placement.
  3. Screed slab surfaces with a straightedge and strike off to correct elevations.
  4. Slope surfaces uniformly, 1/8-inch per foot minimum, to drains where required.
  5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- K. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
  2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials, or on frozen concrete surfaces.
  3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- L. Hot-Weather Placement: Comply with ACI 301 and as follows:
1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of

ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.

2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

### 3.13 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed 1/4-inch in height on formed-surface irregularities.
  1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
  1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete such as waterproofing or another similar system.
- C. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

### 3.14 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in 1 direction. After placing slabs, finish surface to tolerances of F(F) 15 (floor flatness) and F(L) 13 (floor levelness) measured according to ASTM E 1155. Slope surfaces uniformly to drains where required. After leveling, roughen surface before final set with stiff brushes, brooms, or rakes.
  1. Apply scratch finish to surfaces indicated and to receive mortar setting beds for bonded cementitious floor finishes.
- C. Float Finish: After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating, using float blades or float shoes only, when surface water has disappeared, or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth,

granular texture. Finish surfaces to tolerances of F(F) 18 (floor flatness) and F(L) 15 (floor levelness) measured according to ASTM E 1155. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.

1. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied waterproofing.
- D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighen until surface is free of trowel marks and uniform in texture and appearance. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, or another thin-film-finish coating system.
  2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
    - a. Specified overall values of flatness, F(F) 20; and of levelness, F
- E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

### 3.15 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures, unless otherwise indicated, after work of other trades is in place. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations as shown on Drawings. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

### 3.16 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
  - 1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
    - a. Water.
    - b. Continuous water-fog spray.
    - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
  - 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
    - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
    - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
    - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
  - 3. Begin curing operations immediately after placement. Protect concrete from premature drying, excessively hot or cold temperatures, mechanical injury or vandalism.
- F. Stain Prevention: Use special care to prevent petroleum and other stains from forming on concrete surfaces. Comply with at least the following:
  - 1. Diaper all hydraulic powered equipment to avoid staining of concrete.

2. Do not allow vehicles to park on the interior slabs if avoidable. If vehicles are necessary to complete scope of work, place drop cloths below vehicles at all times.
3. Do not use pipe cutting machines on interior floor slabs.
4. Avoid rust staining. Do not allow steel to be placed on interior slab.

### 3.17 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
  1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
  2. Do not apply to concrete that is less than seven days' old.
  3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.
- B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

### 3.18 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
  1. Defer joint filling until concrete has aged at least six months unless otherwise approved by Architect to meet schedule requirements. Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.
- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

### 3.19 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to two and one-half parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.



1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete, but not less than 1 inch in depth. Make edges of cuts perpendicular to concrete surface. Thoroughly clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent. Place patching mortar before bonding agent has dried. No featheredge will be permitted.
  2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
  3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect. If defects cannot be repaired, remove and replace the concrete.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish smoothness and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
  2. After concrete has cured at least 14 days, correct high areas by grinding.
  3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
  4. Correct other low areas scheduled to receive floor coverings with a proprietary repair underlayment when acceptable to Architect. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete..
  6. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Architect's approval.

- G. Where parking may be required, alignment, color and texture must match adjacent concrete and be approved by the Architect.
- H. Architectural Concrete: Use special care repairing concrete exposed to view. Comply with the following:
  - 1. Protect corners, edges, and surfaces of architectural concrete from damage; use guards and barricades.
  - 2. Protect architectural concrete from staining, laitance, and contamination during remainder of construction period.
  - 3. Clean architectural concrete surfaces after finish treatment to remove stains, markings, dust, and debris.
  - 4. Wash and rinse architectural concrete surfaces according to concrete finish applicator's written recommendations. Protect other Work from staining or damage due to cleaning operations.
  - 5. Do not use cleaning materials or processes that could change the appearance of cast-in-place architectural concrete finishes.

### 3.20 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
  - 1. Steel reinforcement placement.
  - 2. Steel reinforcement welding.
  - 3. Headed bolts and studs.
  - 4. Verification of use of required design mixture.
  - 5. Concrete placement, including conveying and depositing.
  - 6. Curing procedures and maintenance of curing temperature.
  - 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
  - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 1 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
    - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
  - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; ASTM C 173/C 173M, volumetric method, for structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
5. Unit Weight: ASTM C 567, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
6. Compression Test Specimens: ASTM C 31/C 31M.
  - a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.
  - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
7. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
  - a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
  - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
8. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
9. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
10. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
11. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
12. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate does not comply with the Contract Documents.

- D. Measure floor and slab flatness and levelness according to ASTM E 1155 within 24 hours of finishing.

### 3.21 PROTECTION OF LIQUID FLOOR TREATMENTS

- A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 03 3000

## SECTION 04 2113 - BRICK MASONRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Atlas brick matching texture and color of existing.
2. Mortar and grout matching color of existing mortar.
3. Point existing mortar joints where needed.
4. Ties and anchors.
5. Miscellaneous masonry accessories.

#### 1.3 SUBMITTALS

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

- B. Shop Drawings: For the following:

1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

- C. Samples:

1. Atlas brick, in the form of straps of five or more bricks.
2. Weep holes/vents.

- D. Material Certificates: For each type and size of the following:

1. Masonry units.
  - a. Include data on material properties.
  - b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
  - c. For exposed exterior brick, include test report for efflorescence according to ASTM C 67.
2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

- E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.
- C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.
- D. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Division 01 Section "Quality Requirements" for mockups.
  - 1. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
  - 2. Clean exposed faces of panels with masonry cleaner indicated.
  - 3. Protect approved sample panels from the elements with weather-resistant membrane.
  - 4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
    - a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

## 1.6 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 cover a minimum of 24 inches down both sides of walls and hold cover securely in place.
  - 2. Where one wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.
- B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
  - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
  - 2. Protect sills, ledges, and projections from mortar droppings.
  - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
  - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
  - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.
- D. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

## PART 2 - PRODUCTS

### 2.1 MASONRY UNITS, GENERAL

- A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

## 2.2 CONCRETE LINTELS

- A. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated. Provide lintels with net-area compressive strength not less than CMUs.

## 2.3 BRICK

- A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent existing units.
  - 1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
  - 2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
  - 3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
  - 4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.
- B. Hollow Brick: ASTM C 652, Grade SW, Class H60V (void areas between 40 and 60 percent of gross cross-sectional area), Type HBS or better.
  - 1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated on structural plans.
  - 2. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
    - a. Sizes (Actual Dimensions): (See Drawings for locations of each)
      - 1) 3-9/16 inches wide by 3-9/16 inches high by 15-9/16 inches long.
      - 2) 5-9/16 inches wide by 3-9/16 inches high by 15-9/16 inches long.
      - 3) 7-9/16 inches wide by 3-9/16 inches high by 15-9/16 inches long.
  - 3. Where shown to "match existing," provide hollow brick matching color range, texture, and size of existing adjacent brickwork.
  - 4. Color and Texture: Matching color of existing buildings on site. See Drawings for locations and transitions from exterior to exterior. Colors will be mixed as follows:
    - a. BR-2 Interior brick: Mix of the following:
      - 70% Manhattan
      - 15% Baja Brown
      - 15% Terracotta
  - 5. Available Products:
    - a. Interstate Brick; Atlas Brick.



- b. Equal, approved by Architect prior to bid.

## 2.4 MORTAR MATERIALS

- A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
- B. Hydrated Lime: ASTM C 207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C 144.
  - 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
  - 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- E. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Euclid Chemical Company (The); Accelguard 80.
    - b. Grace Construction Products, W. R. Grace & Co. - Conn.; Morset.
    - c. Sonneborn Products, BASF Aktiengesellschaft; Trimix-NCA.
- F. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with concrete masonry units, containing integral water repellent by same manufacturer.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ACM Chemistries, Inc.; RainBloc for Mortar.
    - b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
    - c. Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block Mortar Admixture.

## 2.5 REINFORCEMENT

- A. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
- B. Masonry Joint Reinforcement for Veneers Anchored with Seismic Masonry-Veneer Anchors: Single 0.187-inch- diameter, hot-dip galvanized, carbon-steel continuous wire.

## 2.6 TIES AND ANCHORS

- A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
1. Mill-Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 641/A 641M, Class 1 coating.
  2. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
  3. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
- B. Corrugated Metal Ties: Metal strips not less than 7/8 inch wide with corrugations having a wavelength of 0.3 to 0.5 inch and an amplitude of 0.06 to 0.10 inch made from 0.060-inch-thick, steel sheet, galvanized after fabrication.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.
  2. Tie Section: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.25-inch- diameter, hot-dip galvanized steel wire. Mill-galvanized wire may be used at interior walls unless otherwise indicated.

## 2.7 EMBEDDED FLASHING MATERIALS

- A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" and as follows:
1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
  2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
  3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.
    - a. Products: Subject to compliance with requirements, provide one of the following:
      - 1) Cheney Flashing Company; Cheney Flashing (Dovetail) or Cheney 3-Way Flashing (Sawtooth).
      - 2) Keystone Flashing Company, Inc.; Keystone 3-Way Interlocking Thruwall Flashing.
      - 3) Sandell Manufacturing Co., Inc.; Mechanically Keyed Flashing.
  4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflashing.

5. Fabricate through-wall flashing with drip edge unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate through-wall flashing with sealant stop unless otherwise indicated. Fabricate by bending metal back on itself 3/4 inch at exterior face of wall and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
7. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
8. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.
9. Metal Expansion-Joint Strips: Fabricate from stainless steel to shapes indicated.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counterflashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing with a drip edge.
4. Where flashing is fully concealed, use metal flashing.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

## 2.8 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene or urethane.
- B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).
- C. Weep/Vent Products: Use the following unless otherwise indicated:
  1. 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.
    - a. Products: Subject to compliance with requirements, provide the following:
      - 1) Mortar Net USA, Ltd.; Mortar Net Weep Vents.
      - 2) Advanced Building Products Inc.
      - 3) CavClear/Archovations, Inc.
      - 4) Keene Building Products.

- D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Advanced Building Products Inc.; Mortar Break.
    - b. Archovations, Inc.; CavClear Masonry Mat.
    - c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    - d. Mortar Net USA, Ltd.; Mortar Net.
  2. Provide one of the following configurations:
    - a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
    - b. Strips, not less than 3/4 inch thick and 10 inches high, with dimpled surface designed to catch mortar droppings and prevent weep holes from clogging with mortar.

## 2.9 MASONRY CLEANERS

- A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new and existing masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Diedrich Technologies, Inc.
    - b. EaCo Chem, Inc.
    - c. ProSoCo, Inc.

## 2.10 MORTAR MIXES

- A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.
1. Do not use calcium chloride in mortar.
  2. Use portland cement-lime mortar unless otherwise indicated.
  3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

- C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 INSTALLATION, GENERAL

- A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.
- B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.
- C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.
  - 1. Mix units from several pallets or cubes as they are placed.
- D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.
- E. Where existing walls require additional infill, remove cut masonry and match existing adjacent brick. Tooth in new masonry to ensure that patch in wall is not noticeable.
- F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

#### 3.3 TOLERANCES

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

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.
2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.
3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.
- B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in common bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.
1. All facing brick shall be common bond except where indicated otherwise on the Drawings.
  2. Where facing brick is to be single-wythe thickness, header bricks shall be simulated by alternating half-bricks with stretchers at every sixth course.
- C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive

mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

### 3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow brick as follows:
  - 1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
  - 2. With entire units, including areas under cells, fully bedded in mortar at starting course on footings.
- B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

### 3.6 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

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

### 3.7 ANCHORING MASONRY VENEERS

- A. Anchor masonry veneers to wall framing with seismic masonry-veneer anchors to comply with the following requirements:
  - 1. Fasten seismic anchors through sheathing to wall framing with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
  - 2. Insert slip-in anchors in metal studs as sheathing is installed. Provide one anchor at each stud in each horizontal joint between sheathing boards.
  - 3. Embed tie sections in masonry joints. Provide not less than 1 inches of air space between back of masonry veneer and face of sheathing.
  - 4. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
  - 5. Space anchors as indicated, but not more than 18 inches o.c. vertically and 24 inches o.c. horizontally, with not less than 1 anchor for each 2 sq. ft. of wall area. Install additional

anchors within 12 inches of openings and at intervals, not exceeding 8 inches, around perimeter.

### 3.8 EXPANSION JOINTS

- A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form expansion joints in brick as follows:
  - 1. Build flanges of metal expansion strips into masonry. Lap each joint 4 inches in direction of water flow. Seal joints below grade and at junctures with horizontal expansion joints if any.
  - 2. Build flanges of factory-fabricated, expansion-joint units into masonry.
  - 3. Build in compressible joint fillers where indicated.
  - 4. Form open joint full depth of brick wythe and of width indicated, but not less than 1/2 inch for installation of sealant and backer rod specified in Division 07 Section "Joint Sealants."
- C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 9200 "Joint Sealants," but not less than 3/8 inch.
  - 1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

### 3.9 LINTELS

- A. Install steel lintels where indicated.
- B. Provide concrete lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.
- C. Provide minimum bearing of 24 inches at each jamb unless otherwise indicated.

### 3.10 FLASHING, WEEP HOLES, AND CAVITY DRAINAGE

- A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.
- B. Install flashing as follows unless otherwise indicated:
  - 1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal



- penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
  - 2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches; with upper edge tucked under building paper or building wrap, lapping at least 4 inches.
  - 3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
  - 4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
  - 5. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Division 07 Section "Joint Sealants" for application indicated.
  - 6. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.
  - 7. Cut flexible flashing off flush with face of wall after masonry wall construction is completed.
- C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
- 1. Use specified weep/vent products or open head joints to form weep holes.
  - 2. Space weep holes 24 inches o.c. unless otherwise indicated.
- D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

### 3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
- B. Inspections: Level 1 special inspections according to the "International Building Code."
- 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
- C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

### 3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.
- C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
  - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
  - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
  - 3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
  - 4. Clean brick by bucket-and-brush hand-cleaning method described in "BIA Technical Notes 20."
  - 5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
  - 6. Remove all existing efflorescence off existing masonry walls.

### 3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2113

## SECTION 05 1200 - STRUCTURAL STEEL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Structural steel.
  - 2. Grout.

- B. Related Sections:

- 1. Section 01 4000 "Quality Requirements" for independent testing agency procedures and administrative requirements.
  - 2. Section 05 3100 "Steel Decking" for field installation of shear connectors through deck.
  - 3. Section 05 5000 "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.
  - 4. Division 09 painting Sections for surface-preparation and priming requirements.

#### 1.3 DEFINITIONS

- A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- B. Seismic-Load-Resisting System: Elements of structural-steel frame designated as "SLRS" or along grid lines designated as "SLRS" on Drawings, including columns, beams, and braces and their connections.
- C. Heavy Sections: Rolled and built-up sections as follows:
  - 1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
  - 2. Welded built-up members with plates thicker than 2 inches.
  - 3. Column base plates thicker than 2 inches.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated and AISC 360.
2. Use ASD; data are given at service-load level.

B. Construction: Combined system of moment frame and shear walls

## 1.5 SUBMITTALS

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

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections.
5. For structural-steel connections indicated to comply with design loads, include structural design data.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, "Structural Welding Code - Steel," for each welded joint qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand critical welds.

D. Qualification Data: For qualified Installer and fabricator.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

G. Mill test reports for structural steel, including chemical and physical properties.

H. Product Test Reports: For the following:

1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Direct-tension indicators.
3. Tension-control, high-strength bolt-nut-washer assemblies.
4. Shear stud connectors.
5. Shop primers.
6. Nonshrink grout.

I. Source quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator with a minimum of 5 years experience on projects of similar size and complexity that fabricates according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360."
- B. Installer Qualifications: A qualified installer with a minimum of 5 years experience on projects of similar size and complexity."
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
  - 1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.
- E. Comply with applicable provisions of the following specifications and documents:
  - 1. AISC 303.
  - 2. AISC 341 and AISC 341s1.
  - 3. AISC 360.
  - 4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- F. Preinstallation Conference: Conduct conference at Project site.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
  - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.
- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
  - 1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
  - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
  - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

## 1.8 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

## PART 2 - PRODUCTS

### 2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992/A 992M.
- B. Channels, Angles, M , S-Shapes: ASTM A 36/A 36M.
- C. Plate and Bar: ASTM A 36/A 36M.
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B.
  - 1. Weight Class: Standard.
  - 2. Finish: Black.
- F. Welding Electrodes: Comply with AWS requirements.

### 2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.
  - 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.
- C. Unheaded Anchor Rods: ASTM F 1554, Grade 36.

1. Configuration: Straight or Hooked.
2. Nuts: ASTM A 563 heavy-hex carbon steel.
3. Plate Washers: ASTM A 36/A 36M carbon steel.
4. Washers: ASTM F 436, Type 1, hardened carbon steel.
5. Finish: Plain.

D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Plate Washers: ASTM A 36/A 36M carbon steel.
3. Washers: ASTM F 436, Type 1, hardened carbon steel.
4. Finish: Plain.

E. Threaded Rods: ASTM A 36/A 36M.

1. Nuts: ASTM A 563 heavy-hex carbon steel.
2. Washers: ASTM A 36/A 36M carbon steel.
3. Finish: Plain.

## 2.3 PRIMER

- A. Primer: Comply with Division 09 painting Sections.

## 2.4 GROUT

- A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.
- B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

## 2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.
1. Camber structural-steel members where indicated.
  2. Fabricate beams with rolling camber up.
  3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
  4. Mark and match-mark materials for field assembly.
  5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
- F. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.
  1. Cut, drill, or punch holes perpendicular to steel surfaces.
  2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
  3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

## 2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  1. Joint Type: Snug tightened unless noted otherwise.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

## 2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
  1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
  2. Surfaces to be field welded.
  3. Surfaces to be high-strength bolted with slip-critical connections.
- B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
  1. SSPC-SP 3, "Power Tool Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness



of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

## 2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
  1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.
- C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
  1. Liquid Penetrant Inspection: ASTM E 165.
  2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
  3. Ultrasonic Inspection: ASTM E 164.
  4. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, shop-welded shear connectors will be tested and inspected according to requirements in AWS D1.1/D1.1M for stud welding and as follows:
  1. Bend tests will be performed if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  2. Tests will be conducted on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
  1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

### 3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Base Bearing and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
  1. Set plates for structural members on wedges, shims, or setting nuts as required.
  2. Weld plate washers to top of baseplate.
  3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
  4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
  1. Level and plumb individual members of structure.
  2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection.

- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.
- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

### 3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
  - 1. Joint Type: Snug tightened unless noted otherwise.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
  - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
  - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
  - 3. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding tolerances in AISC's "Code of Standard Practice for Steel Buildings and Bridges" for mill material.

### 3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and high-strength bolted connections.
- B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
- C. Welded Connections: Field welds will be visually inspected according to AWS D1.1/D1.1M.
  - 1. In addition to visual inspection, field welds will be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
    - a. Liquid Penetrant Inspection: ASTM E 165.
    - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
    - c. Ultrasonic Inspection: ASTM E 164.
    - d. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
  2. Conduct tests on additional shear connectors if weld fracture occurs on shear connectors already tested, according to requirements in AWS D1.1/D1.1M.
- E. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

### 3.6 REPAIRS AND PROTECTION

- A. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION 05 1200

## SECTION 05 5213 - PIPE AND TUBE RAILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Steel pipe and tube railings.
- B. Related Sections:
  - 1. Section 09 2216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
  - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
  - 1. Handrails and Top Rails of Guards:
    - a. Uniform load of 50 lbf/ ft. applied in any direction.
    - b. Concentrated load of 200 lbf applied in any direction.
    - c. Uniform and concentrated loads need not be assumed to act concurrently.
  - 2. Infill of Guards:
    - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
    - b. Infill load and other loads need not be assumed to act concurrently.

- D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

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

- E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:

- 1. Manufacturer's product lines of mechanically connected railings.
  - 2. Railing brackets.
  - 3. Grout, anchoring cement, and paint products.

- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

- C. Samples for Verification: For each type of exposed finish required.

- 1. Sections of each distinctly different linear railing member, including handrails, top rails, posts, and balusters.
  - 2. Fittings and brackets.

- D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

- E. Qualification Data: For qualified professional engineer.

- F. Welding certificates.

- G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

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

#### 1.6 PROJECT CONDITIONS

- A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

## 1.7 COORDINATION AND SCHEDULING

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorages for railings. 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.
- C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Steel Pipe and Tube Railings:
    - a. Pisor Industries, Inc.
    - b. Wagner, R & B, Inc.; a division of the Wagner Companies.

### 2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

### 2.3 STEEL AND IRON

- A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.
- B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
- C. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- D. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

## 2.4 FASTENERS

- A. General: Provide the following:
  - 1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.
  - 2. Hot-Dip Galvanized Railings: Type 304 stainless-steel or hot-dip zinc-coated steel fasteners complying with ASTM A 153/A 153M or ASTM F 2329 for zinc coating.
- B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
  - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

## 2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
- B. Shop Primers: Provide primers that comply with Division 09 painting Sections.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

## 2.6 FABRICATION

- A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.
- B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.



- C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.
- D. Form work true to line and level with accurate angles and surfaces.
- E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
- F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.
- G. Connections: Fabricate railings with welded connections unless otherwise indicated.
- H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
  - 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 flux immediately.
  - 4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.
- I. Form changes in direction as follows:
  - 1. By bending.
- J. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- K. Close exposed ends of railing members with prefabricated end fittings.
- L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.
- M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
  - 1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers, or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.
- N. Provide inserts and other anchorage devices for connecting railings to masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
- O. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

- P. Rails at Alternated Tread Stair to Roof Hatch: Provide shortened rail at top of stair that extends 5-3/4 inches above top landing of the stair for use within hatch with a standard 12 inch curb.

## 2.7 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Provide exposed fasteners with finish matching appearance, including color and texture, of railings.

## 2.8 STEEL AND IRON FINISHES

- A. For nongalvanized steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves, except galvanize anchors to be embedded in exterior concrete or masonry.
- B. Galvanized Railings:
  - 1. Hot-dip galvanize exterior steel railings, including hardware, after fabrication.
  - 2. Comply with ASTM A 123/A 123M for hot-dip galvanized railings.
  - 3. Comply with ASTM A 153/A 153M for hot-dip galvanized hardware.
  - 4. Fill vent and drain holes that are exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner.
- D. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
  - 1. Railings Indicated to Receive Primers Specified in Division 09 Section "High-Performance Coatings": SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- E. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

1. Shop prime uncoated railings with primers specified in Division 09 painting Sections unless primers specified in Division 09 Section "High-Performance Coatings" are indicated.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements have been clearly marked for Installer. Locate reinforcements and mark locations if not already done.

#### 3.2 INSTALLATION, GENERAL

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
  1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
  2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
  3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- D. Adjust railings before anchoring to ensure matching alignment at abutting joints.
- E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

#### 3.3 RAILING CONNECTIONS

- A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.
- B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

### 3.4 ANCHORING POSTS

- A. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.
- B. Cover anchorage joint with flange of same metal as post, welded to post after placing anchoring material.
- C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:
  - 1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

### 3.5 ATTACHING RAILINGS

- A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends.
- B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends.
- C. Attach railings to wall with wall brackets. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
  - 1. Use type of bracket with flange tapped for concealed anchorage to threaded hanger bolt.
  - 2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.
- D. Secure wall brackets and railing end flanges to building construction as follows:
  - 1. For solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
  - 2. For hollow masonry anchorage, use toggle bolts.
  - 3. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

### 3.6 ADJUSTING AND CLEANING

- A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Division 09 painting Sections.
- B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A 780/A 780M.

3.7 PROTECTION

- A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION 05 5213

## SECTION 06 1053 - MISCELLANEOUS ROUGH CARPENTRY

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

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

#### 1.3 DEFINITIONS

- A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- B. Lumber grading agencies, and the abbreviations used to reference them, include the following:
  - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
  - 2. NHLA: National Hardwood Lumber Association.
  - 3. NLGA: National Lumber Grades Authority.
  - 4. SPIB: The Southern Pine Inspection Bureau.
  - 5. WCLIB: West Coast Lumber Inspection Bureau.
  - 6. WWPA: Western Wood Products Association.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
  - 1. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
  - 2. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
  - 3. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

4. Include copies of warranties from chemical treatment manufacturers for each type of treatment.

## 1.5 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For the following, from ICC-ES:
  1. Fire-retardant-treated wood.
  2. Power-driven fasteners.
  3. Expansion anchors.

## 1.6 QUALITY ASSURANCE

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

## 1.7 DELIVERY, STORAGE, AND HANDLING

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

# PART 2 - PRODUCTS

## 2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
  1. Factory mark each piece of lumber with grade stamp of grading agency.
  2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
  3. Provide dressed lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal thickness or less, 19 percent for more than 2-inch nominal thickness unless otherwise indicated.

## 2.2 FIRE-RETARDANT-TREATED MATERIALS

- A. General: 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 beyond the centerline of the burners at any time during the test.
  - 1. Use treatment that does not promote corrosion of metal fasteners.
  - 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
  - 3. 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.
  - 4. Design Value Adjustment Factors: Treated lumber shall be tested according ASTM D 5664, and design value adjustment factors shall be calculated according to ASTM D 6841.
- 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 testing and inspecting agency acceptable to authorities having jurisdiction.
- E. Application: Treat all miscellaneous carpentry unless otherwise indicated.

## 2.3 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
  - 1. Blocking.
  - 2. Nailers.
- B. For items of dimension lumber size, provide Construction or No. 2 grade lumber of any species.
- C. For concealed boards, provide lumber with 19 percent maximum moisture content and any of the following species and grades:
  - 1. Mixed southern pine, No. 2 grade; SPIB.
  - 2. Northern species, No. 2 Common grade; NLGA.
  - 3. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.



- D. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.
- E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

## 2.4 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: DOC PS 1, Exterior, AC, fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

## 2.5 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
- B. Nails, Brads, and Staples: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Wood Screws: ASME B18.6.1.
- E. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.
- F. Lag Bolts: ASME B18.2.1.
- G. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.
- H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
  - 1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
  - 2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

## PART 3 - EXECUTION

### 3.1 INSTALLATION, GENERAL

- A. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.
- B. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant treated plywood backing panels with classification marking of testing agency exposed to view.
- C. Do not splice structural members between supports unless otherwise indicated.
- D. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.
  - 1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- F. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
  - 1. NES NER-272 for power-driven fasteners.
  - 2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
- G. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

### 3.2 WOOD BLOCKING AND NAILER INSTALLATION

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.

3.3 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.
- B. Protect miscellaneous rough carpentry from weather. If, despite protection, miscellaneous rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 06 1053

## SECTION 06 4116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Plastic-laminate-faced architectural cabinets and shelving.
  - 2. Plastic-laminate laboratory casework.
  - 3. Undercounter flammable and acid storage cabinets.
  - 4. Adjustable sewing table casework.
  - 5. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

- B. Related Requirements:

- 1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
  - 2. Section 09 6513 "Resilient Base and Accessories" for resilient base applied to metal laboratory casework.
  - 3. Section 12 3553 "Laboratory Countertops and Accessories" for epoxy countertops and sink, laboratory accessories, and laboratory service fittings.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 DEFINITIONS

- A. Exposed Surfaces of Casework: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and visible surfaces in open cabinets or behind glass doors.
  - 1. Ends of cabinets, including those installed directly against walls or other cabinets, are defined as "exposed."
  - 2. Ends of cabinets indicated to be installed directly against and completely concealed by walls or other cabinets are defined as "concealed."

- B. Semiexposed Surfaces of Casework: Surfaces behind opaque doors, such as cabinet interiors, shelves, and dividers; interiors and sides of drawers; and interior faces of doors. Tops of cabinets 78 inches or more above floor are defined as "semiexposed."
- C. Concealed Surfaces of Casework: Include sleepers, web frames, dust panels, and other surfaces not usually visible after installation.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product, including high-pressure decorative laminate, adhesive for bonding plastic laminate, and cabinet hardware and accessories.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show details full size.
  - 2. Indicate locations of hardware and keying of locks.
  - 3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
  - 4. Indicate locations of and clearances from adjacent walls, doors, windows, other building components, and other laboratory equipment.
  - 5. Show locations and sizes of cutouts and holes for electrical switches and outlets and other items installed in architectural plastic-laminate cabinets.
- C. Samples for Initial Selection:
  - 1. Plastic laminates.
  - 2. PVC edge material.
  - 3. Thermoset decorative panels.
- D. Samples for Verification:
  - 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish and specified edge material applied to one edge.
  - 2. Thermoset decorative panels, 8 by 10 inches, for each color, pattern, and surface finish, with edge banding on one edge.
  - 3. Corner pieces as follows:
    - a. Cabinet-front frame joints between stiles and rails, as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
    - b. Miter joints for standing trim.
  - 4. Exposed cabinet hardware and accessories, one unit for each type and finish.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For the following:

1. Thermoset decorative panels.
2. High-pressure decorative laminate.
3. Adhesives.

C. Evaluation Reports: For fire-retardant-treated materials, from ICC-ES.

1.7 MAINTENANCE MATERIAL SUBMITTALS (ATTIC STOCK)

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Cabinet Hinges: No fewer than 50 hinges of each type of cabinet hinge installed.
2. Cabinet Mounting Clips and Related Hardware: Quantity equal to 5 percent of amount installed, but no fewer than 20 of each type.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.

B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

C. Laboratory Casework Product Standard: Comply with SEFA 8, "Laboratory Furniture - Casework, Shelving and Tables - Recommended Practices."

D. Flammable Liquid Storage: Where cabinets are indicated for solvent or flammable liquid storage, provide units that are listed and labeled as complying with requirements in NFPA 30 by FM Approvals.

E. Keying Conference: Conduct conference at Project site. Incorporate keying conference decisions into final keying requirements.

F. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of typical plastic-laminate cabinets as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas,

store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

#### 1.10 FIELD CONDITIONS

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

#### 1.11 COORDINATION

- A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.
- B. Coordinate layout and installation of framing and reinforcements for support of laboratory casework.
- C. Coordinate installation of laboratory casework with installation of laboratory equipment.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS FOR LABORATORY CASEWORK

- A. System Structural Performance: Laboratory casework and support framing system shall withstand the effects of the following gravity loads and stresses without permanent deformation, excessive deflection, or binding of drawers and doors:
  - 1. Support Framing System: 600 lb/ft.
  - 2. Suspended Base Cabinets (Internal Load): 160 lb/ft.
  - 3. Shelves: 40 lb/sq. ft.

- B. Delegated Design: Design laboratory casework, including comprehensive engineering analysis by a qualified professional engineer, using seismic performance requirements and design criteria indicated.
- C. Seismic Performance: Laboratory casework and support framing system, including attachments to other work, shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.

## 2.2 ARCHITECTURAL CABINET FABRICATORS

- A. Fabricators: Subject to compliance with requirements, provide products by one of the following:
  - 1. Advanced Cabinets
  - 2. Contempo Cabinet & Mill.
  - 3. Fetzer Architectural Woodwork
  - 4. Fondell Architectural Woodwork, Inc.
  - 5. Granite Mill.
  - 6. Huetter Mill & Cabinet Inc.
  - 7. Johnson Brothers Planing Mill Inc.
  - 8. Pacific Cabinets, Inc.
  - 9. Riverwoods Mill, Inc.
  - 10. Westmark Products, Inc.
  - 11. Wavell-Huber Products, Inc.
- B. Source Limitations: Obtain casework from single source from single manufacturer unless otherwise indicated.

## 2.3 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
  - 1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Custom.
- C. Type of Construction: Frameless.
- D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
- E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.



1. Manufacturers: Provide items PL-2 and PL-3 as indicated on Finish Legend on Sheet AF100 by the following manufacturers or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer:
    - a. Formica Corporation.
    - b. Nevamar
  2. Products: Provide products indicated on Finish Schedule in Drawings, or equivalent product approved by Architect prior to bid and complying with requirements.
- F. Laminate Cladding for Exposed Surfaces:
1. Horizontal Surfaces: Grade HGS.
  2. Postformed Surfaces: Grade HGP.
  3. Vertical Surfaces: Grade HGS.
  4. Edges: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
- G. Materials for Semiexposed Surfaces:
1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
    - a. Edges of Plastic-Laminate Shelves: PVC edge banding, 0.12 inch thick, matching laminate in color, pattern, and finish.
    - b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
    - c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
  2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
  3. Drawer Bottoms: Thermoset decorative panels.
- H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
- I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.
- J. Laboratory Cabinet Construction: Provide plastic-laminate-faced laboratory casework of the following minimum construction:
1. Product: Provide item PL-4 as indicated on Finish Legend on Sheet AF100 by the following manufacturers or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer:
    - a. Wilsonart; Chemsurf

2. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch-thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
  3. Shelves: 3/4-inch-thick plywood, plastic-laminate faced.
  4. Backs of Cabinets: 1/2-inch-thick particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semiexposed surfaces.
  5. Drawer Fronts: 3/4-inch-thick particleboard, plastic-laminate faced.
  6. Drawer Sides and Backs: 1/2-inch-thick thermoset decorative panels, with glued dovetail or multiple-dowel joints.
  7. Drawer Bottoms: 1/4-inch-thick thermoset decorative panels glued and dadoed into front, back, and sides of drawers. Use 1/2-inch-thick material for drawers more than 24 inches wide.
  8. Doors: 3/4 inch thick, with particleboard or MDF cores and solid-wood stiles and rails, plastic-laminate faced.
- K. Laboratory Casework Filler and Closure Panels: Provide where indicated and as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as adjacent exposed cabinet surfaces unless otherwise indicated.
1. Provide utility-space closure panels at spaces between base cabinets where utility space would otherwise be exposed, including spaces below countertops.
  2. Provide closure panels at ends of utility spaces where utility space would otherwise be exposed.
- L. Provide knee-space panels (modesty panels) at spaces between base cabinets, where cabinets are not installed against a wall or where space is not otherwise closed. Fabricate from same material and with same finish as exposed cabinet backs.
- M. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
1. As scheduled.
- 2.4 UNDERCOUNTER FLAMMABLE AND ACID STORAGE CABINETS
- A. Undercounter Acid Cabinets:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Scientific Materials Co., Inc.
    - b. Nuaire, Inc.
  2. Base Cabinet: Construct acid and corrosive base cabinets identified for acid storage, in addition to other casework requirements, of 1 inch, nine ply, exterior-grade plywood with corrosion resistant epoxy paint finish and fully lined polypropylene on all interior walls, shelf, floor and top.
  3. Construct cabinets without metal components inside cabinet.

4. Cabinet Bottom: Include 1 inch lip for containment of spills.
  5. Removable Shelf: 1 corrosion resistant shelf.
  6. Label: Min. 1 inch high, 1/2 inch stroke contracting colored letters: "ACID".
  7. Hardware: Non-metal door catch, strike plate, and hinges.
  8. Venting: Vent cabinet with corrosion resistant pipe at rear of cabinets. Seal opening between working surface and pipe with chemical resistant material.
    - a. Provide vent pipe at rear of cabinet for connection into building exhaust system through fume hood (coordinate with mechanical sub-contractor).
    - b. Coordinate installation of cabinet vent pipes with installation of casework, countertops, and building services to provide easy access to back of cabinet.
  9. Cabinet Size: 24 inches wide by 35.5 inches high by 22 inches deep, unless otherwise indicated.
- B. Acid Storage-Cabinet Lining: 1/4-inch- thick, polyethylene, polypropylene, epoxy, or phenolic-composite lining material.

## 2.5 CABINET HARDWARE AND ACCESSORIES

- A. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 180 degrees of opening, self-closing.
- B. Touch Release Airlift Sewing Machine Lift: Model 1920 Horn Air-Lift Adjustment System as provided by Horn of America, or approved equivalent adjustable sewing machine lift mechanism system approved by Architect prior to bid and complying with requirements.
- C. Back-Mounted Pulls: BHMA A156.9, B02011.
- ~~D.~~ Door and Drawer Pulls for Laboratory Casework: 4-inch, epoxy-coated steel back-mounted wire pulls. Provide 2 pulls for drawers more than 24 inches wide-
1. Color: As selected by Architect from manufacturer's full range of standard colors.
- E. Pulls for Plastic-Laminate Cabinets: 4-inch, back-mounted wire pulls.
1. Finish: Satin Chromium Plated
- F. Typical Catches: Magnetic catches, BHMA A156.9, B03141.
- G. Laboratory Casework Door Catches: Nylon-roller spring catches. Provide 2 catches on doors more than 48 inches high.
- H. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.
- I. Adjustable Shelf Supports for Laboratory Cabinets: Powder-coated steel shelf rests complying with BHMA A156.9, Type B04013.
- J. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold-down clip.

1. Basis of Design Standards: KV 85 Double-slot wall standard as provided by Knappe and Vogt Manufacturing Company.
  2. Basis of Design Brackets: KV 185 Double-flange wall bracket as provided by Knappe and Vogt Manufacturing Company.
  3. Color: Silver.
- K. Wire Book Supports: Hanging bent wire book supports suspended from channel recessed in surface above each shelf.
1. Channel: Standard channel with lip to support hanging wire book supports.
  2. Wire Book Support: Chrome-plated wire bent to triangular shape. Match length, diameter and shape of existing wire book supports.
  3. Provide 1 wire support for every 36 inches of shelving, but not less than 1 wire support per shelf.
- L. Typical Drawer Slides: BHMA A156.9.
1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
  2. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 1.
  3. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
  4. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.
- M. Laboratory Casework Drawer Slides: Side mounted, epoxy-coated steel, self-closing; designed to prevent rebound when drawers are closed; complying with BHMA A156.9, Type B05091.
1. Provide Grade 1HD-100; for drawers not more than 6 inches high and 24 inches wide.
  2. Provide Grade 1HD-200; for drawers more than 6 inches high or 24 inches wide.
  3. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Full-overtravel-extension, ball-bearing type.
- N. Door Locks: BHMA A156.11, E07121.
- O. Drawer Locks: BHMA A156.11, E07041.
- P. Locks for Laboratory Plastic-Laminate Cabinets: Cam type with 5-pin tumbler, brass with chrome-plated finish; complying with BHMA A156.11, Type E07281 or E07261.
1. Provide a minimum of two keys per lock and two master keys.
  2. Provide on all drawers and doors.
  3. Keying: Key locks within each room alike, key each room separately.
  4. Master Key System: Key all locks to be operable by master key.
- Q. Door and Drawer Silencers: BHMA A156.16, L03011.
- R. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.
- S. Label Holders for Laboratory Casework: Stainless steel, aluminum, or chrome plated; sized to receive standard label cards approximately 1 by 2 inches, attached with screws or rivets. Provide on all drawers.
- T. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.
- U. For laboratory casework, provide manufacturer's standard, commercial-quality, heavy-duty hardware complying with requirements indicated for each type.

## 2.6 MISCELLANEOUS MATERIALS

- A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.
- B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.
- C. Adhesives: Do not use adhesives that contain urea formaldehyde.
- D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement, PVA or Resorcinol.
  1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

## 2.7 FABRICATION

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

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of reinforcements, and other conditions affecting performance of laboratory casework.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

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

### 3.3 INSTALLATION

- A. Grade: Install cabinets to comply with same grade as item to be installed.
- B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.
- C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork.
  - 1. Use filler matching finish of items being installed.
- F. Cabinets and Shelving: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
  - 1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  - 2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish.

- G. Wire Book Supports: Install channels to fit snug within recess in shelving surface, with face of channel flush with adjacent surface face.

### 3.4 INSTALLATION OF LABORATORY CABINETS

- A. Comply with installation requirements in SEFA 2.3. Install level, plumb, and true; shim as required, using concealed shims. Where laboratory casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical. Do not exceed the following tolerances:
  - 1. Variation of Tops of Base Cabinets from Level: 1/16 inch in 10 feet.
  - 2. Variation of Bottoms of Upper Cabinets from Level: 1/8 inch in 10 feet.
  - 3. Variation of Faces of Cabinets from a True Plane: 1/8 inch in 10 feet.
  - 4. Variation of Adjacent Surfaces from a True Plane (Lippage): 1/32 inch.
  - 5. Variation in Alignment of Adjacent Door and Drawer Edges: 1/16 inch.
- B. Utility-Space Framing: Secure to floor with two fasteners at each frame. Fasten to partition framing, wood blocking, or metal reinforcements in partitions and to base cabinets.
- C. Base Cabinets: Fasten cabinets to utility-space framing, partition framing, wood blocking, or reinforcements in partitions with fasteners spaced not more than 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform.
  - 1. Where base cabinets are installed away from walls, fasten to floor at toe space at not more than 24 inches o.c. and at sides of cabinets with not less than 2 fasteners per side.
- D. Wall Cabinets: Fasten to hanging strips, masonry, partition framing, blocking, or reinforcements in partitions. Fasten each cabinet through back, near top, at not less than 24 inches o.c.
- E. Install hardware uniformly and precisely. Set hinges snug and flat in mortises.
- F. At sewing tables, install adjustable sewing machine lift uniformly and precisely and in compliance with manufacturer's written instructions.
- G. Adjust laboratory casework and hardware so doors and drawers align and operate smoothly without warp or bind and contact points meet accurately. Lubricate operating hardware as recommended by manufacturer.
- H. Install laboratory casework accessories, countertops, sinks, and fittings specified in Section 12 3553 "Laboratory Countertops and Accessories."

### 3.5 ADJUSTING AND CLEANING

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

- C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 4116



## SECTION 07 2100 - THERMAL INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Glass-fiber blanket insulation.
  - 2. Spray-applied cellulosic acoustical insulation K-13
- B. Related Sections:
  - 1. Section 07 5216 Styrene-Butadiene-Styrene (SBS) Modified Bituminous Membrane Roofing" for insulation specified as part of roofing construction.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.
- C. Research/Evaluation Reports: For foam-plastic insulation, from ICC-ES.

#### 1.4 QUALITY ASSURANCE

- A. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

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

## PART 2 - PRODUCTS

### 2.1 GLASS-FIBER BLANKET INSULATION

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. CertainTeed Corporation.
  - 2. Johns Manville.
  - 3. Knauf Insulation.
  - 4. Owens Corning.
- B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

### 2.2 SPRAY-APPLIED CELLULOSIC INSULATION

- A. Self-Supported, Spray-Applied Cellulosic Insulation: ASTM C1149, Type I (materials applied with liquid adhesive; suitable for either exposed or enclosed applications), chemically treated for flame-resistance, processing, and handling characteristics.
  - 1. Basis-of-Design Product: International Cellulose Corp.; K-13.
    - a. Subject to compliance with requirements, provide Basis of Design Product indicated or a comparable product that meets or exceeds acoustical properties of K-13, by one of the following:
      - 1) GreenFiber.
      - 2) Hamilton Manufacturing Inc.
    - b. Color:
      - 1) Typical Locations: BLACK.
    - c. Acoustic Properties: Meet or exceed acoustical properties of K-13.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean substrates of substances that are harmful to insulation.

### 3.2 INSTALLATION, GENERAL

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

### 3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
  - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
  - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
  - 3. Maintain 3-inch clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
  - 4. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.
- C. Installation of Spray-Applied Cellulosic Thermal Barrier Insulation:
  - a. Install spray-applied cellulosic thermal barrier insulation over spray-foam insulation where exposed, according to manufacturer's recommendations. Cure insulation with continuous natural or mechanical ventilation.
  - b. Apply spray-applied cellulosic thermal barrier insulation at thickness 2".
  - c. Remove and dispose of over-spray.

### 3.4 PROTECTION

- A. Protect installed insulation from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse

and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION 07 2100

## SECTION 07 8100 - APPLIED FIREPROOFING

### 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 sprayed fire-resistive materials (SFRM), applied at steel decking and structural steel in Choral Room, Band Room and office between those rooms.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Framing plans, schedules, or both, indicating the following:
  - 1. Extent of fireproofing for each construction and fire-resistance rating.
  - 2. Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.
  - 3. Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.
  - 4. Treatment of fireproofing after application.
- C. Samples: For each exposed product and for each color and texture specified, 4 inches square in size.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and testing agency.
- B. Product Certificates: For each type of fireproofing.
- C. Evaluation Reports: For fireproofing, from ICC-ES.

- D. Preconstruction Test Reports: For fireproofing.
- E. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A firm or individual certified, licensed, or otherwise qualified by fireproofing manufacturer as experienced and with sufficient trained staff to install manufacturer's products according to specified requirements.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects to set quality standards for materials and execution.
  - 1. Build mockup of each type of fireproofing and different substrate and each required finish as shown on Drawings.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Owner will engage a qualified testing agency to perform preconstruction testing on field mockups of fireproofing.
  - 1. Provide test specimens and assemblies representative of proposed materials and construction.
- B. Preconstruction Adhesion and Compatibility Testing: Test for compliance with requirements for specified performance and test methods.
  - 1. Bond Strength: Test for cohesive and adhesive strength according to ASTM E 736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  - 2. Density: Test for density according to ASTM E 605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.
  - 3. Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.
  - 4. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  - 5. For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers.

## 1.8 FIELD CONDITIONS

- A. Environmental Limitations: Do not apply fireproofing when ambient or substrate temperature is 44 deg F or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and for 24 hours after product application.
- B. Ventilation: Ventilate building spaces during and after application of fireproofing, providing complete air exchanges according to manufacturer's written instructions. Use natural means or, if they are inadequate, forced-air circulation until fireproofing dries thoroughly.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Assemblies: Provide fireproofing, including auxiliary materials, according to requirements of each fire-resistance design and manufacturer's written instructions.
- B. Source Limitations: Obtain fireproofing for each fire-resistance design from single source.
- C. Fire-Resistance Design: Indicated on Drawings, tested according to ASTM E 119 or UL 263 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Steel members are to be considered unrestrained unless specifically noted otherwise.
- D. Asbestos: Provide products containing no detectable asbestos.

### 2.2 SPRAYED FIRE-RESISTIVE MATERIALS

- A. SFRM: Manufacturer's standard, factory-mixed, lightweight, dry formulation, complying with indicated fire-resistance design, and mixed with water at Project site to form a slurry or mortar before conveyance and application or conveyed in a dry state and mixed with atomized water at place of application.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Carbolite Company, subsidiary of RPM International, Fireproofing Products Div.; AD Southwest Fireproofing Type 5GP.
    - b. Grace, W. R. & Co. - Conn.; Grace Construction Products; Monokote MK-6 Series.
    - c. Isolatek International; Cafco 300.
  - 2. Application: Designated for exterior use by a qualified testing agency acceptable to authorities having jurisdiction.
  - 3. Bond Strength: Minimum 150-lbf/sq. ft. cohesive and adhesive strength based on field testing according to ASTM E 736.

4. Density: Not less than 22 lb/cu. ft. and as specified in the approved fire-resistance design, according to ASTM E 605.
5. Thickness: As required for fire-resistance design indicated, measured according to requirements of fire-resistance design or ASTM E 605, whichever is thicker, but not less than 0.375 inch.
6. Combustion Characteristics: ASTM E 136.
7. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - a. Flame-Spread Index: 10 or less.
  - b. Smoke-Developed Index: 10 or less.
8. Compressive Strength: Minimum 100 lbf/sq. in. according to ASTM E 761.
9. Corrosion Resistance: No evidence of corrosion according to ASTM E 937.
10. Deflection: No cracking, spalling, or delamination according to ASTM E 759.
11. Effect of Impact on Bonding: No cracking, spalling, or delamination according to ASTM E 760.
12. Air Erosion: Maximum weight loss of 0.025 g/sq. ft. in 24 hours according to ASTM E 859.
13. Fungal Resistance: Treat products with manufacturer's standard antimicrobial formulation to result in no growth on specimens per ASTM G 21.

## 2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by UL or another testing and inspecting agency acceptable to authorities having jurisdiction for use in fire-resistance designs indicated.
- B. Substrate Primers: Primers approved by fireproofing manufacturer and complying with one or both of the following requirements:
  1. Primer and substrate are identical to those tested in required fire-resistance design by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
  2. Primer's bond strength in required fire-resistance design complies with specified bond strength for fireproofing and with requirements in UL's "Fire Resistance Directory" or in the listings of another qualified testing agency acceptable to authorities having jurisdiction, based on a series of bond tests according to ASTM E 736.
- C. Metal Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required, according to fire-resistance designs indicated and fireproofing manufacturer's written recommendations. Include clips, lathing accessories, corner beads, and other anchorage devices required to attach lath to substrates and to receive fireproofing.
- D. Topcoat: Suitable for application over applied fireproofing; of type recommended in writing by fireproofing manufacturer for each fire-resistance design.



## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for substrates and other conditions affecting performance of the Work and according to each fire-resistance design. Verify compliance with the following:
  - 1. Substrates are free of dirt, oil, grease, release agents, rolling compounds, mill scale, loose scale, incompatible primers, paints, and encapsulants, or other foreign substances capable of impairing bond of fireproofing with substrates under conditions of normal use or fire exposure.
  - 2. Objects penetrating fireproofing, including clips, hangers, support sleeves, and similar items, are securely attached to substrates.
  - 3. Substrates receiving fireproofing are not obstructed by ducts, piping, equipment, or other suspended construction that will interfere with fireproofing application.
- B. Verify that concrete work on steel deck has been completed before beginning fireproofing work.
- C. Verify that roof construction, installation of roof-top HVAC equipment, and other related work is complete before beginning fireproofing work.
- D. Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.
- E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Cover other work subject to damage from fallout or overspray of fireproofing materials during application.
- B. Clean substrates of substances that could impair bond of fireproofing.
- C. Prime substrates where included in fire-resistance design and where recommended in writing by fireproofing manufacturer unless compatible shop primer has been applied and is in satisfactory condition to receive fireproofing.
- D. For applications visible on completion of Project, repair substrates to remove surface imperfections that could affect uniformity of texture and thickness in finished surface of fireproofing. Remove minor projections and fill voids that would telegraph through fire-resistive products after application.

### 3.3 APPLICATION

- A. Construct fireproofing assemblies that are identical to fire-resistance design indicated and products as specified, tested, and substantiated by test reports; for thickness, primers, sealers, topcoats, finishing, and other materials and procedures affecting fireproofing work.
- B. Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation and as required to achieve fire-resistance ratings indicated.
- C. Coordinate application of fireproofing with other construction to minimize need to cut or remove fireproofing.
  - 1. Do not begin applying fireproofing until clips, hangers, supports, sleeves, and other items penetrating fireproofing are in place.
  - 2. Defer installing ducts, piping, and other items that would interfere with applying fireproofing until application of fireproofing is completed.
- D. Metal Decks:
  - 1. Do not apply fireproofing to underside of metal deck substrates until concrete topping, if any, has been completed.
  - 2. Do not apply fireproofing to underside of metal roof deck until roofing has been completed; prohibit roof traffic during application and drying of fireproofing.
- E. Install auxiliary materials as required, as detailed, and according to fire-resistance design and fireproofing manufacturer's written recommendations for conditions of exposure and intended use. For auxiliary materials, use attachment and anchorage devices of type recommended in writing by fireproofing manufacturer.
- F. Spray apply fireproofing to maximum extent possible. Following the spraying operation in each area, complete the coverage by trowel application or other placement method recommended in writing by fireproofing manufacturer.
- G. Extend fireproofing in full thickness over entire area of each substrate to be protected.
- H. Install body of fireproofing in a single course unless otherwise recommended in writing by fireproofing manufacturer.
- I. For applications over encapsulant materials, including lockdown (post-removal) encapsulants, apply fireproofing that differs in color from that of encapsulant over which it is applied.
- J. Where sealers are used, apply products that are tinted to differentiate them from fireproofing over which they are applied.
- K. Provide a uniform finish complying with description indicated for each type of fireproofing material and matching finish approved for required mockups.
- L. Cure fireproofing according to fireproofing manufacturer's written recommendations.

- M. Do not install enclosing or concealing construction until after fireproofing has been applied, inspected, and tested and corrections have been made to deficient applications.
- N. Finishes: Where indicated, apply fireproofing to produce the following finishes:
  - 1. Manufacturer's Standard Finishes: Finish according to manufacturer's written instructions for each finish selected.
  - 2. Spray-Textured Finish: Finish left as spray applied with no further treatment.
  - 3. Rolled, Spray-Textured Finish: Even finish produced by rolling spray-applied finish with a damp paint roller to remove drippings and excessive roughness.
  - 4. Skip-Troweled Finish: Even leveled surface produced by troweling spray-applied finish to smooth out the texture and neaten edges.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
  - 1. Test and inspect as required by the IBC, 1704.10.
- B. Perform the tests and inspections of completed Work in successive stages. Do not proceed with application of fireproofing for the next area until test results for previously completed applications of fireproofing show compliance with requirements. Tested values must equal or exceed values as specified and as indicated and required for approved fire-resistance design.
- C. Fireproofing will be considered defective if it does not pass tests and inspections.
  - 1. Remove and replace fireproofing that does not pass tests and inspections, and retest.
  - 2. Apply additional fireproofing, per manufacturer's written instructions, where test results indicate insufficient thickness, and retest.
- D. Prepare test and inspection reports.

### 3.5 CLEANING, PROTECTING, AND REPAIRING

- A. Cleaning: Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.
- B. Protect fireproofing, according to advice of manufacturer and Installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Completion.
- C. As installation of other construction proceeds, inspect fireproofing and repair damaged areas and fireproofing removed due to work of other trades.
- D. Repair fireproofing damaged by other work before concealing it with other construction.

- E. Repair fireproofing by reapplying it using same method as original installation or using manufacturer's recommended trowel-applied product.

END OF SECTION 07 8100

## SECTION 07 8413 - THROUGH-PENETRATION FIRESTOP SYSTEMS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. This Section includes through-penetration firestop systems for penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items.
- B. Related Sections include the following:
  - 1. Section 07 8446 "Fire-Resistive Joint Systems."

#### 1.2 PERFORMANCE REQUIREMENTS

- A. General: For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
- B. Rated Systems: Provide through-penetration firestop systems with the following ratings determined per UL 1479:
  - 1. F-Rated Systems: Provide through-penetration firestop systems with F-ratings indicated, but not less than that equaling or exceeding fire-resistance rating of constructions penetrated.
  - 2. T-Rated Systems: For the following conditions, provide through-penetration firestop systems with T-ratings indicated, as well as F-ratings, where systems protect penetrating items exposed to potential contact with adjacent materials in occupiable floor areas:
    - a. Penetrations located outside fire-resistance-rated shaft enclosures.
- C. For through-penetration firestop systems exposed to view, traffic, moisture, and physical damage, provide products that, after curing, do not deteriorate when exposed to these conditions both during and after construction.
  - 1. For piping penetrations for plumbing and wet-pipe sprinkler systems, provide moisture-resistant through-penetration firestop systems.
  - 2. For penetrations involving insulated piping, provide through-penetration firestop systems not requiring removal of insulation.
- D. For through-penetration firestop systems exposed to view, provide products with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, as determined per ASTM E 84.

### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated.
  - 1. Submit documentation, including illustrations, from a qualified testing and inspecting agency that is applicable to each through-penetration firestop system configuration for construction and penetrating items.
  - 2. Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular through-penetration firestop condition, submit illustration, with modifications marked, approved by through-penetration firestop system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly.
- C. Through-Penetration Firestop System Schedule: Indicate locations of each through-penetration firestop system, along with the following information:
  - 1. Types of penetrating items.
  - 2. Types of constructions penetrated, including fire-resistance ratings and, where applicable, thicknesses of construction penetrated.
  - 3. Through-penetration firestop systems for each location identified by firestop design designation of qualified testing and inspecting agency.
- D. Qualification Data: For Installer.
- E. Product Certificates: For through-penetration firestop system products, signed by product manufacturer.
- F. Product Test Reports: From a qualified testing agency indicating through-penetration firestop system complies with requirements, based on comprehensive testing of current products.

### 1.4 QUALITY ASSURANCE

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

- C. Source Limitations: Obtain through-penetration firestop systems, for each kind of penetration and construction condition indicated, through one source from a single manufacturer.
- D. Fire-Test-Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those specified in Part 1 "Performance Requirements" Article:
  - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
  - 2. Through-penetration firestop systems are identical to those tested per testing standard referenced in "Part 1 Performance Requirements" Article. Provide rated systems complying with the following requirements:
    - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
    - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
      - 1) UL in its "Fire Resistance Directory."
- E. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver through-penetration firestop system products to Project site in original, unopened containers or packages with intact and legible manufacturers' labels identifying product and manufacturer, date of manufacture, lot number, shelf life if applicable, qualified testing and inspecting agency's classification marking applicable to Project, curing time, and mixing instructions for multicomponent materials.
- B. Store and handle materials for through-penetration firestop systems to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install through-penetration firestop systems when ambient or substrate temperatures are outside limits permitted by through-penetration firestop system manufacturers or when substrates are wet due to rain, frost, condensation, or other causes.
- B. Ventilate through-penetration firestop systems per manufacturer's written instructions by natural means or, where this is inadequate, forced-air circulation.

## 1.7 COORDINATION

- A. Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- B. Coordinate sizing of sleeves, openings, or cut openings to accommodate through-penetration firestop systems.
- C. Notify Owner's inspecting agency at least seven days in advance of through-penetration firestop system installations; confirm dates and times on days preceding each series of installations.
- D. Do not cover up through-penetration firestop system installations that will become concealed behind other construction until each installation has been examined by Owner's inspecting agency and building inspector, if required by authorities having jurisdiction.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Products: Subject to compliance with requirements, through-penetration firestop systems that may be incorporated into the Work include, but are not limited to, those systems indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 that are produced by one of the following manufacturers:
  - 1. Grace, W. R. & Co. - Conn.
  - 2. Hilti, Inc.
  - 3. Nelson Firestop Products.
  - 4. 3M; Fire Protection Products Division.

### 2.2 FIRESTOPPING, GENERAL

- A. Compatibility: Provide through-penetration firestop systems that are compatible with one another; with the substrates forming openings; and with the items, if any, penetrating through-penetration firestop systems, under conditions of service and application, as demonstrated by through-penetration firestop system manufacturer based on testing and field experience.
- B. Accessories: Provide components for each through-penetration firestop system that are needed to install fill materials and to comply with Part 1 "Performance Requirements" Article. Use only components specified by through-penetration firestop system manufacturer and approved by qualified testing and inspecting agency for firestop systems indicated. Accessories include, but are not limited to, the following items:
  - 1. Permanent forming/damming/backing materials, including the following:
    - a. Slag-/rock-wool-fiber insulation.
    - b. Sealants used in combination with other forming/damming/backing materials to prevent leakage of fill materials in liquid state.



- c. Fire-rated form board.
- d. Fillers for sealants.
- 2. Temporary forming materials.
- 3. Substrate primers.
- 4. Collars.
- 5. Steel sleeves.

## 2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by referencing the types of materials described in this Article. Fill materials are those referred to in directories of referenced testing and inspecting agencies as "fill," "void," or "cavity" materials.
- B. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- E. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives.
- I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

## 2.4 MIXING

- A. For those products requiring mixing before application, comply with through-penetration firestop system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
  - 1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
  - 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
  - 3. Remove laitance and form-release agents from concrete.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.
- C. Masking Tape: Use masking tape to prevent through-penetration firestop systems from contacting adjoining surfaces that will remain exposed on completion of Work and that would otherwise be permanently stained or damaged by such contact or by cleaning methods used to remove smears from firestop system materials. Remove tape as soon as possible without disturbing firestop system's seal with substrates.

### 3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with Part 1 "Performance Requirements" Article and with firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
  - 1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.

C. Install fill materials for firestop systems by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:

1. The words "Warning - Through-Penetration Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Through-penetration firestop system designation of applicable testing and inspecting agency.
4. Date of installation.
5. Through-penetration firestop system manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified, independent inspecting agency to inspect through-penetration firestops. Independent inspecting agency shall comply with ASTM E 2174 requirements including those related to qualifications, conducting inspections, and preparing test reports.
- B. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.
- C. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued and firestop installations comply with requirements.

3.6 CLEANING AND PROTECTING

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.

- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

### 3.7 THROUGH-PENETRATION FIRESTOP SYSTEM SCHEDULE

- A. Where UL-classified systems are indicated, they refer to alpha-alpha-numeric designations listed in UL's "Fire Resistance Directory" under product Category XHEZ.
- B. Firestop Systems with No Penetrating Items:
  - 1. Available UL-Classified Systems:
    - a. W-J-0001-0999.
- C. Firestop Systems for Metallic Pipes, Conduit, or Tubing:
  - 1. Available UL-Classified Systems:
    - a. W-J-1001-1999.
- D. Firestop Systems for Nonmetallic Pipe, Conduit, or Tubing:
  - 1. Available UL-Classified Systems:
    - a. W-J-2001-2999.
- E. Firestop Systems for Electrical Cables:
  - 1. Available UL-Classified Systems:
    - a. W-J-3001-3999.
- F. Firestop Systems for Cable Trays:
  - 1. Available UL-Classified Systems:
    - a. W-J-4001-4999.
- G. Firestop Systems for Insulated Pipes:
  - 1. Available UL-Classified Systems:
    - a. W-J-5001-5999.
- H. Firestop Systems for Miscellaneous Electrical Penetrants:
  - 1. Available UL-Classified Systems:

a. W-J-6001-6999.

I. Firestop Systems for Miscellaneous Mechanical Penetrants:

1. Available UL-Classified Systems:

a. W-J-7001-7999.

J. Firestop Systems for Groupings of Penetrants:

1. Available UL-Classified Systems:

a. W-J-8001-8999.

END OF SECTION 07 8413

## SECTION 07 9200 - JOINT SEALANTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Acoustical joint sealants.
5. Replace existing joint sealants.

- B. Related Sections:

1. Division 04 sections for masonry control and expansion joint fillers and gaskets.
2. Section 07 9500 "Expansion Control" for building expansion joints.
3. Division 07 Section "Fire-Resistive Joint Systems" for sealing joints in fire-resistance-rated construction.
4. Section 08 8000 "Glazing" for glazing sealants.
5. Section 09 2900 "Gypsum Board" for sealing perimeter joints.

#### 1.3 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
  1. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
  2. Submit not fewer than eight pieces of each kind of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.
  3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
  4. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.
  5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
  2. Conduct field tests for each application indicated below:
    - a. Each kind of sealant and joint substrate indicated.
  3. Notify Architect seven days in advance of dates and times when test joints will be erected.
  4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
    - a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
  6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

#### 1.4 SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.
- C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.
- D. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
  2. Joint-sealant manufacturer and product name.
  3. Joint-sealant formulation.
  4. Joint-sealant color.
- E. Qualification Data: For qualified Installer and testing agency.

- F. Product Certificates: For each kind of joint sealant and accessory, from manufacturer.
- G. Sealant, Waterproofing, and Restoration Institute (SWRI) Validation Certificate: For each sealant specified to be validated by SWRI's Sealant Validation Program.
- H. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that sealants comply with requirements.
- I. Preconstruction Compatibility and Adhesion Test Reports: From sealant manufacturer, indicating the following:
  - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
  - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- J. Preconstruction Field-Adhesion Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- K. Field-Adhesion Test Reports: For each sealant application tested.
- L. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project and who has a minimum of 5 years experience specializing in installing sealants.
- B. Source Limitations: Obtain each kind of joint sealant from single source from single manufacturer.
- C. Product Testing: Test joint sealants using a qualified testing agency.
  - 1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.
  - 2. Test according to SWRI's Sealant Validation Program for compliance with requirements specified by reference to ASTM C 920 for adhesion and cohesion under cyclic movement, adhesion-in-peel, and indentation hardness.
- D. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.
- E. Preinstallation Conference: Conduct conference at Project site.



## 1.6 PROJECT CONDITIONS

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

## 1.7 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: 20 years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
  2. Disintegration of joint substrates from natural causes exceeding design specifications.
  3. Mechanical damage caused by individuals, tools, or other outside agents.
  4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

- B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):
  - 1. Architectural Sealants: 250 g/L.
  - 2. Sealant Primers for Nonporous Substrates: 250 g/L.
  - 3. Sealant Primers for Porous Substrates: 775 g/L.
- C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

## 2.2 SILICONE JOINT SEALANTS

- A. Single-Component, Nonsag, Neutral-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 795.
    - b. GE Advanced Materials - Silicones; UltraGlaze SSG4000.
    - c. Tremco Incorporated; Tremsil 600.
- B. Single-Component, Nonsag, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 999-A.
    - b. GE Advanced Materials - Silicones; Construction SCS1200.
    - c. Pecora Corporation; 863.
    - d. Tremco Incorporated; Tremsil 300.
- C. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Omniplus.
    - b. Dow Corning Corporation; 786 Mildew Resistant.
    - c. GE Advanced Materials - Silicones; Sanitary SCS1700.
    - d. Tremco Incorporated; Tremsil 200 Sanitary.

## 2.3 URETHANE JOINT SEALANTS

- A. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolastic NP 2.
    - b. Pecora Corporation; Dynatred.
    - c. Sika Corporation, Construction Products Division; Sikaflex - 2c NS.
    - d. Tremco Incorporated; Vulkem 227.

## 2.4 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. BASF Building Systems; Sonolac.
    - b. Pecora Corporation; AC-20+.
    - c. Tremco Incorporated; Tremflex 834.

## 2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Pecora Corporation; AC-20 FTR.
    - b. USG Corporation; SHEETROCK Acoustical Sealant.

## 2.6 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

## 2.7 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
  - 1. Thoroughly remove existing joint sealants and backer rods to accommodate new backer rod and joint sealants.
  - 2. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
  - 3. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
    - a. Concrete.

- b. Masonry.
  - c. Unglazed surfaces of ceramic tile.
- 4. Remove laitance and form-release agents from concrete.
- 5. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
  - a. Metal.
  - b. Glass.
  - c. Porcelain enamel.
  - d. Glazed surfaces of ceramic tile.
- B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

### 3.3 INSTALLATION OF JOINT SEALANTS

- A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - 1. Do not leave gaps between ends of sealant backings.
  - 2. Do not stretch, twist, puncture, or tear sealant backings.
  - 3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
  - 1. Place sealants so they directly contact and fully wet joint substrates.
  - 2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
  2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
  3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.
- G. Acoustical Sealant Installation: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations.

### 3.4 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
1. Extent of Testing: Test completed and cured sealant joints as follows:
    - a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
    - b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.
  2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
    - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
  3. Inspect tested joints and report on the following:
    - a. Whether sealants filled joint cavities and are free of voids.
    - b. Whether sealant dimensions and configurations comply with specified requirements.
    - c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant fill, sealant configuration, and sealant dimensions.
5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

### 3.5 CLEANING

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

### 3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

### 3.7 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces JS-1.

1. Joint Locations:
  - a. Isolation and contraction joints in cast-in-place concrete slabs.
  - b. Tile control and expansion joints.
  - c. Joints between different materials listed above.
  - d. Other joints as indicated.
2. Urethane Joint Sealant: Multicomponent, nonsag, traffic grade, Class 25.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces JS-2.

1. Joint Locations:

- a. Construction joints in cast-in-place concrete.
    - b. Joints between plant-precaster architectural concrete units.
    - c. Control and expansion joints in unit masonry.
    - d. Joints between metal panels.
    - e. Joints between different materials listed above.
    - f. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
    - g. Control and expansion joints in overhead surfaces.
    - h. Other joints as indicated.
  2. Silicone Joint Sealant: Single component, nonsag, neutral curing and Class 25 Single component, nonsag, acid curing.
  3. Urethane Joint Sealant: Multicomponent, nonsag,, Class 25.
  4. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Exterior and interior joints in vertical non-porous surfaces and horizontal nontraffic surfaces JS-3.
  1. Joint Locations:
    - a. Joints between metal panels.
    - b. Joints between metal panels and glass.
    - c. Joints between glass panels.
    - d. Cracks in existing concrete floor slabs, 1/16 inches or wider.
    - e. Joints between different materials listed above.
    - f. Other joints as indicated.
  2. Silicone Joint Sealant: Single component, nonsag, acid curing.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces JS-5.
  1. Joint Sealant Location:
    - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
    - b. Tile control and expansion joints where indicated.
    - c. Other joints as indicated.
  2. Joint Sealant: Single component, nonsag, mildew resistant, acid curing.
  3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces where silicone or urethane sealants are not otherwise indicated and movement capacity and weathering characteristics are not critical. JS-6.
  1. Joint Locations:
    - a. Control and expansion joints on exposed interior surfaces of exterior walls.
    - b. Tile control and expansion joints.



- c. Vertical joints on exposed surfaces of interior unit masonry, concrete walls, and partitions.
    - d. Joints on underside of plant-precast structural concrete beams and planks.
    - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
    - f. Other exposed interior joints as indicated.
  - 2. Joint Sealant: Latex or acrylic based.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces JS-7.
- 1. Joint Location:
    - a. Acoustical joints where indicated.
    - b. Other joints as indicated.
  - 2. Joint Sealant: Acoustical.
  - 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 07 9200

## SECTION 08 1113 - 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 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Standard hollow metal doors and frames.
  - 2. Metal panels at transoms and sidelights.
  - 3. Refurbishing of existing doors, frames and metals panels indicated to remain.

- B. Related Sections:

- 1. Section 04 2113 "Brick Unit Masonry" for embedding anchors for hollow metal work into masonry construction.
  - 2. Section 08 7100 "Door Hardware" for door hardware for hollow metal doors.
  - 3. Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting" for field painting hollow metal doors and frames.
  - 4. Division 26 Sections for electrical connections including conduit and wiring for door controls and operators.

#### 1.3 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.
- B. Standard Hollow Metal Work: Hollow metal work fabricated according to ANSI/SDI A250.8.

#### 1.4 COORDINATION

- A. Coordinate anchorage installation for hollow-metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

#### 1.5 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

## 1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, and finishes.
- B. Shop Drawings: Include the following:
  - 1. Elevations of each door design.
  - 2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
  - 3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
  - 4. Locations of reinforcement and preparations for hardware.
  - 5. Details of each different wall opening condition.
  - 6. Details of anchorages, joints, field splices, and connections.
  - 7. Details of accessories.
  - 8. Details of moldings, removable stops, and glazing.
  - 9. Details of conduit and preparations for power, signal, and control systems.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification:
  - 1. For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches.
  - 2. For the following items, prepared on Samples about 12 by 12 inches to demonstrate compliance with requirements for quality of materials and construction:
    - a. Doors: Show vertical-edge, top, and bottom construction; core construction; and hinge and other applied hardware reinforcement. Include separate section showing glazing if applicable.
    - b. Frames: Show profile, corner joint, floor and wall anchors, and silencers. Include separate section showing fixed hollow metal panels and glazing if applicable.
- E. Schedule: Provide a schedule of hollow metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with door hardware schedule.

## 1.7 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each type of hollow metal door and frame assembly.

## 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
  - 1. Provide additional protection to prevent damage to finish of factory-finished units.

- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Do not store in a manner that traps excess humidity.
  - 1. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

## 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Amweld Building Products, LLC.
  - 2. Benchmark; a division of Therma-Tru Corporation.
  - 3. Ceco Door Products; an Assa Abloy Group company.
  - 4. Curries Company; an Assa Abloy Group company.
  - 5. Deansteel Manufacturing Company, Inc.
  - 6. Firedoor Corporation.
  - 7. Fleming Door Products Ltd.; an Assa Abloy Group company.
  - 8. Habersham Metal Products Company.
  - 9. Kewanee Corporation (The).
  - 10. Mesker Door Inc.
  - 11. Pioneer Industries, Inc.
  - 12. Security Metal Products Corp.
  - 13. Steelcraft; an Ingersoll-Rand company.
  - 14. Windsor Republic Doors.
- B. Source Limitations: Obtain hollow metal work from single source from single manufacturer.

### 2.2 REGULATORY REQUIREMENTS

- A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

- B. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and 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 257 or UL 9.

## 2.3 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.
- D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z coating designation; mill phosphatized.
  - 1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.
- F. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.
- G. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-development indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- H. Glazing: Comply with requirements in Division 08 Section "Glazing."
- I. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

## 2.4 STANDARD HOLLOW METAL DOORS

- A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8.
  - 1. Design: Flush panel.
  - 2. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core.
  - 3. Vertical Edges for Single-Acting Doors: Beveled edge.

- a. Beveled Edge: 1/8 inch in 2 inches.
- 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- thick, end closures or channels of same material as face sheets.
- 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.
- C. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

## 2.5 STANDARD HOLLOW METAL FRAMES

- A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
  - 1. Fabricate frames with mitered or coped corners.
  - 2. Fabricate frames as full profile welded unless otherwise indicated.
  - 3. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
- C. Interior Frames: Fabricated from cold-rolled steel sheet.
  - 1. Fabricate frames with mitered or coped corners.
  - 2. Fabricate frames as full profile welded unless otherwise indicated.
  - 3. Frames for Level 2 Steel Doors: 0.053-inch- thick steel sheet.
  - 4. Frames for Level 3 Steel Doors: 0.053-inch- thick steel sheet.
  - 5. Frames for Wood Doors: 0.053-inch- thick steel sheet.
  - 6. Frames for Borrowed Lights: 0.053-inch- thick steel sheet.
- D. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 with reinforcement plates from same material as frames.

## 2.6 HOLLOW-METAL SPANDREL PANELS

- A. Provide hollow-metal panels, at transoms and sidelites, of same materials, construction, fire-rating, and finish as adjacent door assemblies.

## 2.7 FRAME ANCHORS

- A. Jamb Anchors:
  - 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.

2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.
4. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch-diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

## 2.8 STOPS AND MOLDINGS

- A. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.
- B. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, fabricated from same material as frames in which they are installed.

## 2.9 ACCESSORIES

- A. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.
- B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

## 2.10 FABRICATION

- A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.
- C. Hollow Metal Doors:
  1. Fire Door Cores: As required to provide fire-protection ratings indicated.
- D. Hollow Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
  1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
  2. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
  4. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
  5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
  6. Jamb Anchors: Provide number and spacing of anchors as follows:
    - a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Two anchors per jamb up to 60 inches high.
      - 2) Three anchors per jamb from 60 to 90 inches high.
      - 3) Four anchors per jamb from 90 to 120 inches high.
      - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
    - b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      - 1) Three anchors per jamb up to 60 inches high.
      - 2) Four anchors per jamb from 60 to 90 inches high.
      - 3) Five anchors per jamb from 90 to 96 inches high.
      - 4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      - 5) Two anchors per head for frames above 42 inches wide and mounted in metal-stud partitions.
    - c. Compression Type: Not less than two anchors in each jamb.
    - d. Postinstalled Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.
  7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Keep holes clear during construction.
    - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
    - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- E. Fabricate concealed stiffeners, edge channels, and hardware reinforcement from either cold- or hot-rolled steel sheet.
- F. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."
1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
  2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.



3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
  4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.
- G. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
  2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
  3. Provide loose stops and moldings on inside of hollow metal work.
  4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

## 2.11 CLEANING MATERIALS (FOR EXISTING METAL SURFACES)

- A. Manufacturers of Chemical Cleaners: Subject to compliance with requirements, provide products by one of the following:
1. Back to Nature Products Company.
  2. Dumond Chemicals, Inc.
  3. Hydroclean; Hydrochemical Techniques, Inc.
  4. PROSOCO, Inc.
- B. Water: Potable.
- C. Hot Water: Water heated to a temperature of 140 to 160 deg F.
- D. Job-Mixed Detergent Solution: Solution prepared by mixing 2 cups of tetrasodium polyphosphate, 1/2 cup of laundry detergent, 5 quarts of 5 percent sodium hypochlorite bleach, and 15 quarts of hot water for every 5 gal. of solution required.
- E. Nonacidic Liquid Chemical Cleaner: Manufacturer's standard mildly alkaline liquid cleaner, formulated for removing organic soiling from ordinary building materials including polished stone, brick, copper, brass, bronze, aluminum, stainless steel, plastics, wood, and glass.
- F. Abrasive Materials:
1. Abrasive Pads for Copper-Alloy Cleaning: Extra fine bronze wool or plastic abrasive pads.

## 2.12 STEEL FINISHES

- A. Repair Primer: Manufacturer's standard, rust-inhibiting, fast-curing, lead- and chromate-free, universal primer, compatible with firmly adhered existing paint and applied finish. Comply with

coating manufacturer's written instructions for cleaning, pretreatment, application, and minimum dry-film thickness.

- B. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.
  - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- C. Finish Primer: Primer complying with applicable requirements in Division 09 Section "Interior Painting" or "Exterior Painting" for finish painting of primed metal doors, frames, and panels.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.
- C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.
- B. Prior to installation, adjust and securely brace welded hollow metal frames for squareness, alignment, twist, and plumbness to the following tolerances:
  - 1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - 2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - 3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - 4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

- C. Drill and tap doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.

### 3.3 INSTALLATION

- A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11.
  - 1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
    - a. At fire-rated openings, install frames according to NFPA 80.
    - b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
    - c. Install frames with removable glazing stops located on secure side of opening.
    - d. Install door silencers in frames before grouting.
    - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    - f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    - g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
  - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
    - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
  - 3. Metal-Stud Partitions: Solidly pack mineral-fiber insulation behind frames.
  - 4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
  - 5. In-Place Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 6. In-Place Gypsum Board Partitions: Secure frames in place with postinstalled expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
  - 7. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.

8. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
  - a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
  - b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
  - c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
  - d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.
- C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.
  1. Non-Fire-Rated Standard Steel Doors:
    - a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    - b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    - c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    - d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.
  2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.
- D. Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.
  1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

### 3.4 REPAIR PROCEDURES, GENERAL

- A. Repair Metal Item: Match existing materials and features, retaining as much original material as possible to complete the repair.
  1. Unless otherwise indicated, repair existing metal frames, doors, and panels indicated to remain, by removing dents and scratches and patching with Bondo or another product that thoroughly fills unwanted depressions, scratches, and holes and will not be noticeable after repainting of the surface.
  2. Where necessary, repair metal by limited replacement matching existing material.
- B. Repaint: Prepare existing painted hollow metal doors, frames and panels by cleaning surface, removing less than firmly adhered existing paint, removing dents, holes, and scratches, filling dents, holes and scratches as needed, sanding edges smooth, and priming for painting as specified.

3.5 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.
- B. Remove grout and other bonding material from hollow metal work immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- D. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 1113

## SECTION 08 1416 - FLUSH WOOD DOORS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Solid-core doors with wood-veneer faces.
  - 2. Factory finishing flush wood doors.
  - 3. Factory fitting flush wood doors to frames and factory machining for hardware.

- B. Related Sections:

- 1. Section 08 8000 "Glazing" for glass view panels in flush wood doors.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of door indicated. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

- B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.

- 1. Indicate dimensions and locations of mortises and holes for hardware.
  - 2. Indicate dimensions and locations of cutouts.
  - 3. Indicate requirements for veneer matching.
  - 4. Indicate doors to be factory finished and finish requirements.
  - 5. Fire-protection ratings for fire-rated doors.

- C. Samples for Verification:

- 1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
  - 2. Corner sections of doors, approximately 8 by 10 inches, with door faces and edges representing actual materials to be used.
    - a. Provide samples for species of veneer and solid lumber required.
    - b. Provide samples for color, texture, and pattern of plastic laminate required.

3. Louver blade and frame sections, 6 inches long, for each material and finish specified.
4. Frames for light openings, 6 inches long, for each material, type, and finish required.

D. Warranty: Sample of special warranty.

#### 1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain flush wood doors from single manufacturer.
- B. Quality Standard: In addition to requirements specified, comply with AWI's "Architectural Woodwork Quality Standards Illustrated."
  1. Provide AWI Quality Certification Labels or an AWI letter of licensing for Project indicating that doors comply with requirements of grades specified.
- C. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in plastic bags or cardboard cartons.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

#### 1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

#### 1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to, the following:
    - a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
    - b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
  2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
  3. Warranty Period for Solid-Core Interior Doors: Life of installation.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Provide items WD-2 by VT Industries Inc. as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:
1. Graham; an Assa Abloy Group company.
  2. Marshfield Door Systems, Inc.
  3. Oshkosh Architectural Door Company.
  4. VT Industries Inc.

### 2.2 DOOR CONSTRUCTION, GENERAL

- A. WDMA I.S.1-A Performance Grade:
1. Heavy Duty unless otherwise indicated.
  2. Extra Heavy Duty: Classrooms, public toilets, janitor's closets, assembly spaces, and exits.
  3. Standard Duty: Closets (not including janitor's closets).
- B. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
  2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
- C. Particleboard-Core Doors:
1. Particleboard: ANSI A208.1, Grade LD-2, made with binder containing no urea-formaldehyde resin.
  2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
  3. Provide doors with glued-wood-stave cores instead of particleboard cores for doors indicated to receive exit devices.

### 2.3 VENEERED-FACED DOORS FOR TRANSPARENT FINISH

- A. Interior Solid-Core Doors:
1. Grade: Custom (Grade A faces).
  2. Species: White Maple.
  3. Cut: Plain sliced (flat sliced).



4. Match between Veneer Leaves: Book match.
5. Assembly of Veneer Leaves on Door Faces: Center-balance match.
6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
7. Room Match: Match door faces within each separate room or area of building. Corridor-door faces do not need to match where they are separated by 10 feet or more.
8. Exposed Vertical and Top Edges: Same species as faces.
9. Core: Particleboard.
10. Construction: Five plies. Stiles and rails are bonded to core, then entire unit abrasive planed before veneering. Faces are bonded to core using a hot press.
11. WDMA I.S.1-A Performance Grade: As indicated.

## 2.4 LIGHT FRAMES

- A. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- thick, cold-rolled steel sheet; with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

## 2.5 FABRICATION

- A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting unless otherwise indicated.
  1. Comply with requirements in NFPA 80 for fire-rated doors.
- B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
  1. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.
- C. Openings: Cut and trim openings through doors in factory.
  1. Light Openings: Trim openings with moldings of material and profile indicated.
  2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

## 2.6 FACTORY FINISHING

- A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
  1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

- B. Finish doors at factory.
- C. Transparent Finish:
  - 1. Grade: Custom.
  - 2. Finish: AWI catalyzed polyurethane system.
  - 3. Staining: Stain as indicated for item WD-2 on Finish Legend in Drawings. Match Architect's sample.
  - 4. Effect: Open-grain finish.
  - 5. Sheen: Satin.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine doors and installed door frames before hanging doors.
  - 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
  - 2. Reject doors with defects.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Hardware: For installation, see Division 08 Section "Door Hardware."
- B. Installation Instructions: Install doors to comply with manufacturer's written instructions and the referenced quality standard, and as indicated.
  - 1. Install fire-rated doors according to NFPA 80.
- C. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
- D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

#### 3.3 ADJUSTING

- A. Operation: Rehang or replace doors that do not swing or operate freely.
- B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416

130015 OPT0417878 Version 1

Door#	HwSet#
A118B	01
B127A	02
B127B	02
B127C	04
B127D	03

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware
2. Electronic access control system components

B. Section excludes:

1. Windows
2. Cabinets (casework), including locks in cabinets
3. Signage
4. Toilet accessories
5. Overhead doors

C. Related Sections:

1. Division 01 "General Requirements" sections for Allowances, Alternates, Owner Furnished Contractor Installed, Project Management and Coordination.
2. Division 06 Section "Rough Carpentry"
3. Division 06 Section "Finish Carpentry"
4. Division 07 Section "Joint Sealants" for sealant requirements applicable to threshold installation specified in this section.
5. Division 08 Sections:
  - a. "Metal Doors and Frames"
  - b. "Flush Wood Doors"
  - c. "Stile and Rail Wood Doors"
  - d. "Interior Aluminum Doors and Frames"
  - e. "Aluminum-Framed Entrances and Storefronts"
  - f. "Stainless Steel Doors and Frames"
  - g. "Special Function Doors"
  - h. "Entrances"
6. Division 26 "Electrical" sections for connections to electrical power system and for low-voltage wiring.
7. Division 28 "Electronic Safety and Security" sections for coordination with other components of electronic access control system and fire alarm system.

1.02 REFERENCES

A. UL LLC

1. UL 10B - Fire Test of Door Assemblies
2. UL 10C - Positive Pressure Test of Fire Door Assemblies
3. UL 1784 - Air Leakage Tests of Door Assemblies
4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute

1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Keying Systems and Nomenclature
4. Installation Guide for Doors and Hardware

C. NFPA – National Fire Protection Association

1. NFPA 70 – National Electric Code
2. NFPA 80 – 2016 Edition – Standard for Fire Doors and Other Opening Protectives
3. NFPA 101 – Life Safety Code
4. NFPA 105 – Smoke and Draft Control Door Assemblies
5. NFPA 252 – Fire Tests of Door Assemblies

D. ANSI - American National Standards Institute

1. ANSI A117.1 – 2017 Edition – Accessible and Usable Buildings and Facilities
2. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties
3. ANSI/BHMA A156.28 - Recommended Practices for Keying Systems
4. ANSI/WDMA I.S. 1A - Interior Architectural Wood Flush Doors
5. ANSI/SDI A250.8 - Standard Steel Doors and Frames

1.03 SUBMITTALS

A. General:

1. Submit in accordance with Conditions of Contract and Division 01 Submittal Procedures.
2. Prior to forwarding submittal:
  - a. Review drawings and Sections from related trades to verify compatibility with specified hardware.
  - b. Highlight, encircle, or otherwise specifically identify on submittals: deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.

B. Action Submittals:

1. Product Data: Submit technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:
  - a. Wiring Diagrams: For power, signal, and control wiring and including:
    - 1) Details of interface of electrified door hardware and building safety and security systems.
    - 2) Schematic diagram of systems that interface with electrified door hardware.
    - 3) Point-to-point wiring.
    - 4) Risers.
3. Door Hardware Schedule:

- a. Submit concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work critical in Project construction schedule.
  - b. Submit under direct supervision of a Door Hardware Institute (DHI) certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule published by DHI.
  - c. Indicate complete designations of each item required for each opening, include:
    - 1) Door Index: door number, heading number, and Architect's hardware set number.
    - 2) Quantity, type, style, function, size, and finish of each hardware item.
    - 3) Name and manufacturer of each item.
    - 4) Fastenings and other pertinent information.
    - 5) Location of each hardware set cross-referenced to indications on Drawings.
    - 6) Explanation of all abbreviations, symbols, and codes contained in schedule.
    - 7) Mounting locations for hardware.
    - 8) Door and frame sizes and materials.
    - 9) Degree of door swing and handing.
    - 10) Operational Description of openings with electrified hardware covering egress, ingress (access), and fire/smoke alarm connections.
4. Key Schedule:
- a. After Keying Conference, provide keying schedule that includes levels of keying, explanations of key system's function, key symbols used, and door numbers controlled.
  - b. Use ANSI/BHMA A156.28 "Recommended Practices for Keying Systems" as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
  - c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
  - d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
  - e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion. Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
  - f. Prepare key schedule by or under supervision of supplier, detailing Owner's final keying instructions for locks.
- C. Informational Submittals:
- 1. Provide Qualification Data for Supplier, Installer and Architectural Hardware Consultant.
  - 2. Provide Product Data:
    - a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
    - b. Include warranties for specified door hardware.
- D. Closeout Submittals:
- 1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
    - a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
    - b. Catalog pages for each product.
    - c. Final approved hardware schedule edited to reflect conditions as installed.

- d. Final keying schedule
- e. Copy of warranties including appropriate reference numbers for manufacturers to identify project.
- f. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.

#### 1.04 QUALITY ASSURANCE

##### A. Qualifications and Responsibilities:

1. Supplier: Recognized architectural hardware supplier with a minimum of 5 years documented experience supplying both mechanical and electromechanical door hardware similar in quantity, type, and quality to that indicated for this Project. Supplier to be recognized as a factory direct distributor by the manufacturer of the primary materials with a warehousing facility in the Project's vicinity. Supplier to have on staff, a certified Architectural Hardware Consultant (AHC) or Door Hardware Consultant (DHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.
2. Installer: Qualified tradesperson skilled in the application of commercial grade hardware with experience installing door hardware similar in quantity, type, and quality as indicated for this Project.
3. Architectural Hardware Consultant: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:
  - a. For door hardware: DHI certified AHC or DHC.
  - b. Can provide installation and technical data to Architect and other related subcontractors.
  - c. Can inspect and verify components are in working order upon completion of installation.
  - d. Capable of producing wiring diagram and coordinating installation of electrified hardware with Architect and electrical engineers.
4. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.
5. Smoke and Draft Control Door Assemblies:
  - a. Provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105
  - b. Comply with the maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at tested pressure differential of 0.3-inch wg (75 Pa) of water.
6. Electrified Door Hardware
  - a. Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.
7. Accessibility Requirements:
  - a. Comply with governing accessibility regulations cited in "REFERENCES" article 087100, 1.02.D3 herein for door hardware on doors in an accessible route. This project must comply with all Federal Americans with Disability Act regulations and all Local Accessibility Regulations.

##### B. Pre-Installation Meetings

1. Keying Conference

- a. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
  - 1) Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
  - 2) Preliminary key system schematic diagram.
  - 3) Requirements for key control system.
  - 4) Requirements for access control.
  - 5) Address for delivery of keys.
2. Pre-installation Conference
  - a. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
  - b. Inspect and discuss preparatory work performed by other trades.
  - c. Inspect and discuss electrical roughing-in for electrified door hardware.
  - d. Review sequence of operation for each type of electrified door hardware.
  - e. Review required testing, inspecting, and certifying procedures.
  - f. Review questions or concerns related to proper installation and adjustment of door hardware.
3. Electrified Hardware Coordination Conference:
  - a. Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

#### 1.05 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site. Promptly replace products damaged during shipping.
- B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package. Deliver each article of hardware in manufacturer's original packaging.
- C. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
- D. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.
- E. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

#### 1.06 COORDINATION

- A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.
- B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.



- C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.
- D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

#### 1.07 WARRANTY

- A. Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within published warranty period.
  - 1. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.
  - 2. Warranty Period: Beginning from date of Substantial Completion, for durations indicated in manufacturer's published listings.
    - a. Mechanical Warranty
      - 1) Locks
        - a) Schlage ND Series
      - 2) Exit Devices
        - a) Von Duprin 98
      - 3) Closers
        - a) LCN 4000 Series

#### 1.08 MAINTENANCE

- A. Turn over unused materials to Owner for maintenance purposes.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. The Owner requires use of certain products for their unique characteristics and project suitability to ensure continuity of existing and future performance and maintenance standards. After investigating available product offerings, the Awarding Authority has elected to prepare proprietary specifications. These products are specified with the notation: "No Substitute."
  - 1. Where "No Substitute" is noted, submittals and substitution requests for other products will not be considered.
- B. Approval of alternate manufacturers and/or products other than those listed as "Scheduled Manufacturer" or "Acceptable Manufacturers" in the individual article for the product category are only to be considered by official substitution request in accordance with section 01 25 00.
- C. Approval of products from manufacturers indicated in "Acceptable Manufacturers" is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer's product.

- D. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect's approval.

## 2.02 MATERIALS

### A. Fabrication

1. Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. provide screws according to manufacturer's recognized installation standards for application intended.
2. Finish exposed screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners wherever possible for hardware units exposed when door is closed. Coordinate with "Metal Doors and Frames", "Flush Wood Doors", "Stile and Rail Wood Doors" to ensure proper reinforcements. Advise the Architect where visible fasteners, such as thru bolts, are required.

- B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

### C. Cable and Connectors:

1. Where scheduled in the hardware sets, provide each item of electrified hardware and wire harnesses with number and gage of wires enough to accommodate electric function of specified hardware.
2. Provide Molex connectors that plug directly into connectors from harnesses, electric locking and power transfer devices.
3. Provide through-door wire harness for each electrified locking device installed in a door and wire harness for each electrified hinge, electrified continuous hinge, electrified pivot, and electric power transfer for connection to power supplies.

## 2.03 HINGES

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Ives 5BB series
2. Acceptable Manufacturers and Products:
  - a. McKinney TB series
  - b. Best FBB series

### B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. Provide five knuckle, ball bearing hinges.
3. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
  - a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high

- b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
- 4. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
  - a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 5. 2 inches or thicker doors:
  - a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
  - b. Interior: Heavy weight, steel, 5 inches (127 mm) high
- 6. Adjust hinge width for door, frame, and wall conditions to allow proper degree of opening.
- 7. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
- 8. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
  - a. Steel Hinges: Steel pins
  - b. Non-Ferrous Hinges: Stainless steel pins
  - c. Out-Swinging Exterior Doors: Non-removable pins
  - d. Out-Swinging Interior Lockable Doors: Non-removable pins
  - e. Interior Non-lockable Doors: Non-rising pins
- 9. Provide hinges with electrified options as scheduled in the hardware sets. Provide with number and gage of wires enough to accommodate electric function of specified hardware. Locate electric hinge at second hinge from bottom or nearest to electrified locking component. Provide mortar guard for each electrified hinge specified.

## 2.04 CYLINDRICAL LOCKS – GRADE 1

### A. Manufacturers and Products:

- 1. Scheduled Manufacturer and Product:
  - a. Schlage ND series (owner standard)

### B. Requirements:

- 1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3-hour fire doors.
- 2. Indicators: Where specified, provide escutcheon with lock status indicator window on top of lockset rose:
  - a. Escutcheon height (including rose) 6.05 inches high by 3.68 inches wide.
  - b. Indicator window measuring a minimum 3.52-inch by .60 inch with 1.92 square-inches of front facing viewing area and 180-degree visibility with a total of .236 square-inches of total viewable area.
  - c. Provide snap-in serviceable window to prevent tampering. Lock must function if indicator is compromised.
  - d. Provide messages color-coded with full text and symbol, as scheduled, for easy visibility.
  - e. Unlocked and Unoccupied message will display on white background, and Locked and Occupied message will display on red background.
- 3. Cylinders: Refer to "KEYING" article, herein.
- 4. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2-inch latch throw. Provide proper latch throw for UL listing at pairs.
- 5. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.

6. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
7. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
8. Provide electrified options as scheduled in the hardware sets.
9. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.
  - a. Vandlgard: Provide levers with vandal resistant technology for use at heavy traffic or abusive applications.
  - b. Lever Design: RHO

## 2.05 EXIT DEVICES

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Von Duprin 98/35A series (owner standard)

### B. Requirements:

1. Provide exit devices tested to ANSI/BHMA A156.3 Grade 1 and UL listed for Panic Exit or Fire Exit Hardware.
2. Cylinders: Refer to "KEYING" article, herein.
3. Provide smooth touchpad type exit devices, fabricated of brass, bronze, stainless steel, or aluminum, plated to standard architectural finishes to match balance of door hardware.
4. Touchpad must extend a minimum of one half of door width. No plastic inserts are allowed in touchpads.
5. Provide exit devices with deadlatching feature for security and for future addition of alarm kits and/or other electrified requirements.
6. Provide exit devices with weather resistant components that can withstand harsh conditions of various climates and corrosive cleaners used in outdoor pool environments.
7. Provide flush end caps for exit devices.
8. Provide exit devices with manufacturer's approved strikes.
9. Provide exit devices cut to door width and height. Install exit devices at height recommended by exit device manufacturer, allowable by governing building codes, and approved by Architect.
10. Mount mechanism case flush on face of doors or provide spacers to fill gaps behind devices. Where glass trim or molding projects off face of door, provide glass bead kits.
11. Provide cylinder or hex-key dogging as specified at non fire-rated openings.
12. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed.
13. Provide factory drilled weep holes for exit devices used in full exterior application, highly corrosive areas, and where noted in hardware sets.
14. Provide electrified options as scheduled.
15. Top latch mounting: double- or single-tab mount for steel doors, face mount for aluminum doors eliminating requirement of tabs, and double tab mount for wood doors.
16. Provide exit devices with optional trim designs to match other lever and pull designs used on the project.

## 2.06 CYLINDERS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. Schlage (owner standard)

B. Requirements:

1. Provide cylinders/cores, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer's series as indicated. Refer to "KEYING" article, herein.

2.07 KEYING

A. Scheduled System: To be verified with owner.

1. New factory registered system:
  - a. Provide a factory registered keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
2. Existing factory registered system:
  - a. Provide cylinders/cores keyed into Owner's existing factory registered keying system. Comply with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.
3. Existing non-factory registered system:
  - a. Provide cylinders/cores keyed into Owner's existing keying system managed by Owner's locksmith, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference. Contact:
    - 1) Firm Name:
    - 2) Contact Person:
    - 3) Telephone:

B. Requirements:

1. Permanent Keying:
  - a. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
    - 1) Master Keying system as directed by the Owner.
  - b. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
  - c. Provide keys with the following features:
    - 1) Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
    - 2) Patent Protection: Keys and blanks protected by one or more utility patent(s).
    - 3) Geographically Exclusive: Where High Security or Security cylinders/cores are indicated, provide nationwide, geographically exclusive key system complying with the following restrictions.
  - d. Identification:
    - 1) Mark permanent cylinders/cores and keys with applicable blind code for identification. Do not provide blind code marks with actual key cuts.
    - 2) Identification stamping provisions must be approved by the Architect and Owner.

- 3) Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
- 4) Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
- 5) Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.
- e. Quantity: Furnish in the following quantities.
  - 1) Permanent Control Keys: 3.
  - 2) Master Keys: 6.
  - 3) Change (Day) Keys: 3 per cylinder/core that is keyed differently
  - 4) Key Blanks: Quantity as determined in the keying meeting.

## 2.08 KEY CONTROL SYSTEM

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Telkee
2. Acceptable Manufacturers:
  - a. HPC
  - b. Lund

### B. Requirements:

1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
  - a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
  - b. Provide hinged-panel type cabinet for wall mounting.

## 2.09 DOOR CLOSERS

### A. Manufacturers and Products:

1. Scheduled Manufacturer and Product:
  - a. LCN 4040XP series (owner standard)

### B. Requirements:

1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2-inch (38 mm) diameter piston with 5/8-inch (16 mm) diameter double heat-treated pinion journal. QR code with a direct link to maintenance instructions.

4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards. Provide snap-on cover clip, with plastic covers, that secures cover to spring tube.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck. Provide graphically labelled instructions on the closer body adjacent to each adjustment valve. Provide positive stop on reg valve that prevents reg screw from being backed out.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.
11. Closers shall be capable of being upgraded by adding modular mechanical or electronic components in the field.

## 2.10 PROTECTION PLATES

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Trimco
  - b. Rockwood

### B. Requirements:

1. Provide protection plates with a minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes plates 2 inches (51 mm) less width of door on single doors, pairs of doors with a mullion, and doors with edge guards. Size plates 1 inch (25 mm) less width of door on pairs without a mullion or edge guards.
3. At fire rated doors, provide protection plates over 16 inches high with UL label.

## 2.11 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturers:
  - a. Glynn-Johnson (owner standard)

### B. Requirements:

1. Provide overhead stop at any door where conditions do not allow for a wall stop or floor stop presents tripping hazard.

## 2.12 DOOR STOPS AND HOLDERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives (owner standard)

### B. Provide door stops at each door leaf:

1. Provide wall stops wherever possible. Provide concave type where lockset has a push button of thumbturn.
2. Where a wall stop cannot be used, provide universal floor stops.
3. Where wall or floor stop cannot be used, provide overhead stop.
4. Provide roller bumper where doors open into each other and overhead stop cannot be used.

## 2.13 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Zero International
2. Acceptable Manufacturers:
  - a. National Guard
  - b. Pemko

### B. Requirements:

1. Provide thresholds, weather-stripping, and gasketing systems as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.
4. Size thresholds 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width unless otherwise specified in the hardware sets or detailed in the drawings.

## 2.14 SILENCERS

### A. Manufacturers:

1. Scheduled Manufacturer:
  - a. Ives
2. Acceptable Manufacturers:
  - a. Rockwood
  - b. Trimco

### B. Requirements:



1. Provide "push-in" type silencers for hollow metal or wood frames.
2. Provide one silencer per 30 inches (762 mm) of height on each single frame, and two for each pair frame.
3. Omit where gasketing is specified.

## 2.15 FINISHES

### A. FINISH: BHMA 626/652 (US26D); EXCEPT:

1. Hinges at Exterior Doors: BHMA 630 (US32D)
2. Aluminum Geared Continuous Hinges: BHMA 628 (US28)
3. Push Plates, Pulls, and Push Bars: BHMA 630 (US32D)
4. Protection Plates: BHMA 630 (US32D)
5. Overhead Stops and Holders: BHMA 630 (US32D)
6. Door Closers: Powder Coat to Match
7. Wall Stops: BHMA 630 (US32D)
8. Latch Protectors: BHMA 630 (US32D)
9. Weatherstripping: Clear Anodized Aluminum
10. Thresholds: Mill Finish Aluminum

## PART 3 - EXECUTION

### 3.01 EXAMINATION

- A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance. Verify doors, frames, and walls have been properly reinforced for hardware installation.
- B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
- C. Submit a list of deficiencies in writing and proceed with installation only after unsatisfactory conditions have been corrected.

### 3.02 INSTALLATION

- A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.
  1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
  2. Custom Steel Doors and Frames: HMMA 831.
  3. Interior Architectural Wood Flush Doors: ANSI/WDMA I.S. 1A
  4. Installation Guide for Doors and Hardware: DHI TDH-007-20
- B. Install door hardware in accordance with NFPA 80, NFPA 101 and provide post-install inspection, testing as specified in section 1.03.E unless otherwise required to comply with governing regulations.

- C. Install each hardware item in compliance with manufacturer's instructions and recommendations, using only fasteners provided by manufacturer.
- D. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.
- E. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.
- F. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
- G. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.
- H. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated.
- I. Lock Cylinders:
  - 1. Install construction cores to secure building and areas during construction period.
  - 2. Replace construction cores with permanent cores as indicated in keying section.
  - 3. Furnish permanent cores to Owner for installation.
- J. Wiring: Coordinate with Division 26, ELECTRICAL and Division 28 ELECTRONIC SAFETY AND SECURITY sections for:
  - 1. Conduit, junction boxes and wire pulls.
  - 2. Connections to and from power supplies to electrified hardware.
  - 3. Connections to fire/smoke alarm system and smoke evacuation system.
  - 4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
  - 5. Connections to panel interface modules, controllers, and gateways.
  - 6. Testing and labeling wires with Architect's opening number.
- K. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
- L. Continuous Hinges: Re-locate the door and frame fire rating labels where they will remain visible so that the hinge does not cover the label once installed.
- M. Door Closers & Auto Operators: Mount closers/operators on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers/operators so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.
- N. Overhead Stops/Holders: Mount overhead stops/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.
- O. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.
- P. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

- Q. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.
- R. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.
- S. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.
- T. Door Bottoms and Sweeps: Apply to bottom of door, forming seal with threshold when door is closed.

### 3.03 ADJUSTING

- A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.
  - 1. Spring Hinges: Adjust to achieve positive latching when door can close freely from an open position of 30 degrees.
  - 2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
  - 3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
- B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

### 3.04 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items per manufacturer's instructions to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

### 3.05 DOOR HARDWARE SCHEDULE

- A. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier's responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.
- B. Discrepancies, conflicting hardware, and missing items are to be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application.

C. Hardware items are referenced in the following hardware schedule. Refer to the above specifications for special features, options, cylinders/keying, and other requirements.

D. Hardware Sets:

130015 OPT0417878 Version 1

Legend:

 Link to catalog cut sheet






 Electrified Opening

Hardware Group No. 01

For use on Door #(s):

A118B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	VANDL STOREROOM LOCK	ND96PD RHO KEYWAY AS REQUIRED		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
1	EA	GASKETING	188FSBK @ HEAD AND JAMBS		BK	ZER







Hardware Group No. 02

For use on Door #(s):

B127A

B127B





Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5 NRP		652	IVE
1	EA	PANIC HARDWARE	LD-98-L-2SI-06		626	VON
2	EA	RIM CYLINDER	20-022 KEYWAY AS REQUIRED		626	SCH
1	EA	RIM CYL THUMBTURN	XB11-979/XB13-379 (OPTION FOR -2SI IF KEYED CYLINDER NOT ACCEPTABLE)		626	SCH
1	EA	SURFACE CLOSER	4040XP SCUSH TBWMS		689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS		630	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 03

For use on Door #(s):  
B127D





Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94P6D RHO KEYWAY AS REQUIRED		626	SCH
1	EA	WALL STOP	WS406/WS407 CCV/CVX AS REQUIRED		626	IVE
3	EA	SILENCER	SR64		GRY	IVE

Hardware Group No. 04

For use on Door #(s):  
B127C

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER		FINISH	MFR
3	EA	HINGE	5BB1 4.5 X 4.5		652	IVE
1	EA	VANDL CLASSROOM LOCK	ND94P6D RHO KEYWAY AS REQUIRED		626	SCH
1	EA	OH STOP	90S J		630	GLY
3	EA	SILENCER	SR64		GRY	IVE

END OF SECTION

## SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
  - 2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

#### 1.3 ACTION SUBMITTALS

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

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: For dimpled steel studs and runners, from ICC-ES.

### PART 2 - PRODUCTS

#### 2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

#### 2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
  - 1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
  - 2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

- B. Studs and Runners: ASTM C 645. Use either steel studs and runners or dimpled steel studs and runners.
  - 1. Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: 0.033 inch.
    - b. Depth: As indicated on Drawings.
  - 2. Dimpled Steel Studs and Runners:
    - a. Minimum Base-Metal Thickness: 0.025 inch.
    - b. Depth: As indicated on Drawings.
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
  - 1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
  - 2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.
- D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
  - 1. Minimum Base-Metal Thickness: 0.033 inch.
- E. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
  - 1. Depth: As indicated on Drawings.
  - 2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.
- F. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
  - 1. Minimum Base-Metal Thickness: 0.033 inch.
  - 2. Depth: As indicated on Drawings.
- G. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
  - 1. Configuration: Asymmetrical or hat shaped.
- H. Resilient Clips: Apply to furring at acoustically sensitive rooms.
- I. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
  - 1. Depth: As indicated on Drawings.

2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.

## 2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch- diameter wire, or double strand of 0.048-inch- diameter wire.
- B. Hanger Attachments to Concrete:
  1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
    - a. Type: Postinstalled, chemical anchor.
  2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.
- C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.
- D. Flat Hangers: Steel sheet, in size indicated on Drawings.
- E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch- wide flanges.
  1. Depth: As indicated on Drawings.
- F. Furring Channels (Furring Members):
  1. Cold-Rolled Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges, 3/4 inch deep.
  2. Steel Studs and Runners: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.033 inch.
    - b. Depth: As indicated on Drawings.
  3. Dimpled Steel Studs and Runners: ASTM C 645.
    - a. Minimum Base-Metal Thickness: 0.025 inch.
    - b. Depth: As indicated on Drawings.
  4. Hat-Shaped, Rigid Furring Channels: ASTM C 645, 7/8 inch deep.



- a. Minimum Base-Metal Thickness: 0.033 inch.
- 5. Resilient Furring Channels: 1/2-inch- deep members designed to reduce sound transmission.
  - a. Configuration: Asymmetrical or hat shaped.

## 2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
  - 1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
  - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
  - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

## 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 of the Work.
- B. 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 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 non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

### 3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C 754.
  - 1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.
- B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- C. Install bracing at terminations in assemblies.
- D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

### 3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
  - 1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
  - 2. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
  - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
  - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
    - a. Install two studs at each jamb unless otherwise indicated.
    - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
  - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
5. Curved Partitions:
  - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
  - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs 6 inches o.c.

E. Direct Furring:

1. Attach to masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

### 3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches (1219 mm) o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.
3. Furring Channels (Furring Members): 16 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
  - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
  - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for

- structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
  - 5. Do not attach hangers to steel roof deck.
  - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
  - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
  - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 2216

## SECTION 09 2900 - GYPSUM BOARD

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Interior gypsum board.
- 2. Tile backing panels.

- B. Related Requirements:

- 1. Section 09 2216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

#### 1.3 ACTION SUBMITTALS

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

- B. Samples: For the following products:

- 1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

#### 1.4 QUALITY ASSURANCE

- A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

- 1. Install mockups for the following:

- a. Each level of gypsum board finish indicated for use in exposed locations.
- b. Each texture finish indicated.

- 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
- 3. Simulate finished lighting conditions for review of mockups.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

## 1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
  1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

### 2.2 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

### 2.3 INTERIOR GYPSUM BOARD

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. American Gypsum.
  2. CertainTeed Corp.
  3. Georgia-Pacific Gypsum LLC.

4. National Gypsum Company.
5. PABCO Gypsum.
6. Temple-Inland.
7. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered.

C. Flexible Gypsum Board: ASTM C 1396/C 1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: 1/4 inch.
2. Long Edges: Tapered.

D. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

E. Abuse-Resistant Gypsum Board: ASTM C 1629/C 1629M, Level 1.

1. Core: 5/8 inch, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10.

## 2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. C-Cure; C-Cure Board 990.
  - b. CertainTeed Corp.; FiberCement BackerBoard.
  - c. Custom Building Products; Wonderboard.
  - d. National Gypsum Company, Permabase Cement Board.
  - e. USG Corporation; DUROCK Cement Board.

2. Thickness: 1/2 inch.

## 2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.

2. Shapes:

- a. Cornerbead.
- b. L-Bead: L-shaped; exposed long flange receives joint compound.
- c. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475/C 475M.
- B. Joint Tape:
  1. Interior Gypsum Board: Paper.
  2. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
  1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
  2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
    - a. Use setting-type compound for installing paper-faced metal trim accessories.
  3. Fill Coat: For second coat, use setting-type, sandable topping compound.
  4. Finish Coat: For third coat, use drying-type, all-purpose compound.
- D. Joint Compound for Tile Backing Panels:
  1. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
- B. 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.
- C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
- D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through



perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Pecora Corporation; AC-20 FTR.
  - b. Specified Technologies, Inc.; Smoke N Sound Acoustical Sealant.
  - c. USG Corporation; SHEETROCK Acoustical Sealant.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C 840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc., except in chases braced internally).
  1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
  2. Fit gypsum panels around ducts, pipes, and conduits.

3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
  1. Type X: Vertical surfaces unless otherwise indicated.
  2. Flexible Type: Apply in double layer at curved assemblies.
  3. Ceiling Type: Ceiling surfaces.
  4. Abuse-Resistant Type: Lower 8 feet of secondary corridor walls.
- B. Single-Layer Application:
  1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
  2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
    - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
  3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- C. Curved Surfaces:
  1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus 12-inch- long straight sections at ends of curves and tangent to them.

2. For double-layer construction, fasten base layer to studs with screws 16 inches o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced 12 inches o.c.

### 3.4 APPLYING TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A108.11, at showers and where indicated.
- B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

### 3.5 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints at locations indicated on Drawings, or if not indicated, according to ASTM C 840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
  1. Cornerbead: Use at outside corners unless otherwise indicated.
  2. L-Bead: Use where indicated.

### 3.6 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
  1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
  2. Level 2: Panels that are substrate for tile.
  3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
    - a. Primer and its application to surfaces are specified in other Division 09 Sections.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
  - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
  - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900

## SECTION 09 3000 - TILING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Ceramic tile.
  - 2. Waterproof membrane.
  - 3. Crack isolation membrane.
  - 4. Tile backing panels.
  - 5. Metal edge strips.

- B. Related Sections:

- 1. Section 07 9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
  - 2. Section 09 2900 "Gypsum Board" for cementitious backer units.

#### 1.3 DEFINITIONS

- A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.
- B. ANSI A108 Series: ANSI A108.01, ANSI A108.02, ANSI A108.1A, ANSI A108.1B, ANSI A108.1C, ANSI A108.4, ANSI A108.5, ANSI A108.6, ANSI A108.8, ANSI A108.9, ANSI A108.10, ANSI A108.11, ANSI A108.12, ANSI A108.13, ANSI A108.14, ANSI A108.15, ANSI A108.16, and ANSI A108.17, which are contained in "American National Standard Specifications for Installation of Ceramic Tile."
- C. Module Size: Actual tile size plus joint width indicated.
- D. Face Size: Actual tile size, excluding spacer lugs.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.

## 1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.
- C. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.
- D. Samples for Verification:
  1. Full-size units of each type and composition of tile and for each color and finish required.
  2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inches square, but not fewer than 4 tiles. Use grout of type and in color or colors approved for completed Work.
  3. Full-size units of each type of trim and accessory for each color and finish required.
  4. Stone thresholds in 6-inch lengths.
  5. Metal edge strips in 6-inch lengths.
- E. Qualification Data: For qualified Installer.
- F. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.
- G. Product Certificates: For each type of product, signed by product manufacturer.
- H. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

## 1.6 QUALITY ASSURANCE

- A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
  1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
- B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.
- C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
  1. Waterproof membrane.

2. Crack isolation membrane.
3. Joint sealants.
4. Cementitious backer units.
5. Metal edge strips.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
- B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
- D. Store liquid materials in unopened containers and protected from freezing.
- E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

#### 1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

#### 1.9 EXTRA MATERIALS

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

2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

## PART 2 - PRODUCTS

### 2.1 PRODUCTS, GENERAL

- A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
  1. Provide tile complying with Standard grade requirements unless otherwise indicated.
- B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCA installation methods specified in tile installation schedules, and other requirements specified.
- C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.
- D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
  1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.
- E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

### 2.2 TILE PRODUCTS

- A. Tile Types CT-1, Glazed wall tile.
  1. Basis of Design Products: Provide items CT-1 Elevare by Dal-Tile International Inc. as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturers:
  2. Module Size: 4 by 16 inch as indicated.
  3. Thickness: 5/16 inch.
  4. Face: Plain with modified square edges or cushion edges.
  5. Finish: As indicated.
  6. Tile Pattern: Running bond as indicated.
  7. Tile Color: As indicated on Finish Legend on Sheet AF100.
  8. Grout Color: As indicated by manufacturer's designations.
  9. Mounting: Factory, back mounted.



## 2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: As specified in Section 09 2900 "Gypsum Board."

## 2.4 WATERPROOF MEMBRANE

- A. General: Manufacturer's standard product, selected from the following, that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.
- B. Polyethylene Sheet: Polyethylene faced on both sides with fleece webbing; 0.008-inch nominal thickness.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Schluter Systems L.P.; KERDI.
- C. Fabric-Reinforced, Fluid-Applied Membrane: System consisting of liquid-latex rubber or elastomeric polymer and continuous fabric reinforcement.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Bostik, Inc.; Hydroment Blacktop 90210.
    - b. Custom Building Products; 9240 Waterproofing and Anti-Fracture Membrane.
    - c. Laticrete International, Inc.; Laticrete 9235 Waterproof Membrane.
    - d. MAPEI Corporation; Mapelastic L (PRP M19).
    - e. Mer-Kote Products, Inc.; Hydro-Guard 2000.
- D. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; Redgard Waterproofing and Crack Prevention Membrane.
    - b. Laticrete International, Inc.; Latapoxy 24hr HydroProofing.
    - c. MAPEI Corporation; Mapelastic HPG.
- E. Latex-Portland Cement: Flexible mortar consisting of cement-based mix and latex additive.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. MAPEI Corporation; Mapelastic (PRP 315).

## 2.5 CRACK ISOLATION MEMBRANE

- A. General: Manufacturer's standard product that complies with ANSI A118.12 for standard performance and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

- B. Corrugated Polyethylene: Corrugated polyethylene with dovetail-shaped corrugations and with anchoring webbing on the underside; 3/16-inch nominal thickness.

1. Products: Subject to compliance with requirements, provide one of the following:

- a. Schluter Systems L.P.; DITRA.
- b. Custom Building products: Spiderweb.

## 2.6 SETTING MATERIALS

- A. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Custom Building Products.
- b. Laticrete International, Inc.
- c. MAPEI Corporation.
- d. Mer-Kote Products, Inc.

2. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.

## 2.7 GROUT MATERIALS

- A. Polymer-Modified Tile Grout: ANSI A118.7.

1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

- a. Custom Building Products.
- b. Laticrete International, Inc.
- c. MAPEI Corporation.

2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

## 2.8 ELASTOMERIC SEALANTS

- A. General: Provide sealants, primers, backer rods, and other sealant accessories that comply with the following requirements and with the applicable requirements in Division 07 Section "Joint Sealants."

## 2.9 MISCELLANEOUS MATERIALS

- A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.
- B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
- C. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
  - 1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
  - 2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.
- D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
- E. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Custom Building Products; Surfaceguard Sealer.
    - b. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.

## 2.10 MIXING MORTARS AND GROUT

- A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
- B. Add materials, water, and additives in accurate proportions.
- C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
  - 1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
  - 2. Verify that concrete substrates for tile floors installed with bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.
    - a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
    - b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.
  - 3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.
  - 4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.
- C. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

### 3.3 TILE INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
  - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
    - a. Tile floors in wet areas.
    - b. Tile floors composed of tiles 8 by 8 inches or larger.
    - c. Tile floors composed of rib-backed tiles.
- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
  - 1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
  - 2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
  - 3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.
- E. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
  - 1. Glazed Wall Tile: 1/16 inch.
- F. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
  - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
  - 2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."
- G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
2. Do not extend cleavage membrane or crack isolation membrane under thresholds set in latex-portland cement mortar. Fill joints between such thresholds and adjoining tile set on crack isolation membrane with elastomeric sealant.

H. Metal Edge Strips: Install at all outside exposed edges of ceramic tile locations.

I. Grout Sealer: Apply grout sealer to grout joints in tile floors according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

### 3.4 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.

### 3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

### 3.6 CRACK ISOLATION MEMBRANE INSTALLATION

A. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

B. Do not install tile or setting materials over crack isolation membrane until membrane has cured.

### 3.7 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.

1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.
- B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.
- C. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.
- D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

### 3.8 INTERIOR TILE INSTALLATION SCHEDULE

- A. Interior Walls, Metal Studs or Furring:
  1. W243: Thin-set mortar on gypsum board.
    - a. Tile Type: Typical tile walls.
    - b. Mortar: Latex-portland cement mortar.
    - c. Grout: Polymer-modified sanded or polymer-modified unsanded grout.
  2. W244: Thin-set mortar on cementitious backer units or fiber cement underlayment.
    - a. Tile Type: Tile at wet areas other than showers.
    - b. Mortar: Latex- portland cement mortar.
    - c. Grout: Polymer-modified sanded grout.

END OF SECTION 09 3000

## SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

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

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Suspended ceiling components.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Size and location of initial access modules for acoustical panels.
  - 4. Items penetrating finished ceiling including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Sprinklers.
    - e. Access panels.
  - 5. Perimeter moldings.
- B. Qualification Data: For testing agency.



- C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and fastener type, from ICC-ES.
- D. Field quality-control reports.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
  - 2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
  - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.
  - 4. Impact Clips: Equal to 2 percent of quantity installed.

#### 1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
  - 1. Build mockup of typical ceiling area as shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

## 1.10 FIELD CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
  - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
  - 2. Smoke-Developed Index: 50 or less.

### 2.2 ACOUSTICAL PANELS, GENERAL

- A. Source Limitations:
  - 1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
  - 2. Suspension System: Obtain each type from single source from single manufacturer.
- B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.
- C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
  - 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.
- D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.
  - 1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

## 2.3 TYPICAL ACOUSTICAL PANELS

- A. Manufacturers: Provide item ACT-1, Ultima Square Lay-In by Armstrong World Industries, Inc. as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:
  - 1. Armstrong World Industries, Inc.
  - 2. CertainTeed Corp.
  - 3. Chicago Metallic Corporation.
  - 4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Classification: Provide panels complying with ASTM E 1264 for type, form, and pattern as follows:
  - 1. Type and Form: Type IV, mineral base with membrane-faced overlay; Form 1, nodular and Form 2, water felted;; with washable surface.
  - 2. Pattern: C (perforated, small holes) and G (smooth).
- C. Color: White.
- D. LR: Not less than 0.89.
- E. NRC: Not less than 0.80.
- F. CAC: Not less than 35.
- G. Edge/Joint Detail: Square.
- H. Thickness: 7/8 inch.
- I. Modular Size: 24 by 48 inches.
- J. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

## 2.4 METAL SUSPENSION SYSTEMS, GENERAL

- A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
- B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
  - 1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a

load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

- a. Type: Postinstalled expansion or Postinstalled bonded anchors.
  - b. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
  - c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.
- C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
  2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
  3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch- diameter wire.
- D. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.
- E. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- F. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- G. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.
- H. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

## 2.5 METAL SUSPENSION SYSTEM

- A. Manufacturers: Provide suspension systems indicated in items ACT-1 and ACT-2 on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
4. Cap Material: Steel cold-rolled sheet.
5. Cap Finish: Painted white.

## 2.6 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Armstrong World Industries, Inc.
2. CertainTeed Corp.
3. Chicago Metallic Corporation.
4. USG Interiors, Inc.; Subsidiary of USG Corporation.

- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

## 2.7 ACOUSTICAL SEALANT

- A. Products: Subject to compliance with requirements, provide one of the following:

1. Acoustical Sealant for Exposed and Concealed Joints:
  - a. Pecora Corporation; AC-20 FTR Acoustical and Insulation Sealant.
  - b. USG Corporation; SHEETROCK Acoustical Sealant.
2. Acoustical Sealant for Concealed Joints:
  - a. Henkel Corporation; OSI Pro-Series SC-175 Acoustical Sound Sealant.

- b. Pecora Corporation; AIS-919.
  - c. Tremco, Inc.; Tremco Acoustical Sealant.
- B. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
  - 1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.
  - 2. Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant.
  - 3. Acoustical sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.
- B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

#### 3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
  6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
  7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  8. Do not attach hangers to steel deck tabs.
  9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
  2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
  3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension-system runners and moldings.

2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
3. Install impact clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.
4. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

### 3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  1. Compliance of seismic design.
- B. Perform the following tests and inspections of completed installations of acoustical panel ceiling hangers and anchors and fasteners in successive stages. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
  1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
    - a. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
    - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- C. Acoustical panel ceiling hangers and anchors and fasteners will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

### 3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113



## SECTION 09 5413 – OPEN METAL MESH CEILINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes open metal wire ceiling panels and metal suspension systems for interior ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete.

#### 1.2 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of sizes indicated below:
  - 1. Wire Mesh Panels: Two full-size Samples of type, color, and pattern.
  - 2. Exposed Suspension-System Members: 6-inch- long Samples of type, finish, and color.
  - 3. Clips: Full-size impact and seismic clips.
- C. Delegated-Design Submittal: For seismic restraints for ceiling systems.
  - 1. Include design calculations for seismic restraints including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Ceiling suspension-system members.
  - 2. Structural members to which suspension systems will be attached.
  - 3. Method of attaching hangers to building structure.
    - a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.

4. Carrying channels or other supplemental support for hanger-wire attachment where conditions do not permit installation of hanger wires at required spacing.
5. Size and location of initial access modules for metal mesh panels.
6. Items penetrating finished ceiling and ceiling-mounted items including the following:
  - a. Lighting fixtures.
  - b. Diffusers.
  - c. Grilles.
  - d. Speakers.
  - e. Sprinklers.
  - f. Access panels.
  - g. Perimeter moldings.
7. Show operation of hinged and sliding components covered by or adjacent to metal mesh panels.
8. Minimum Drawing Scale: 1/4 inch = 1 foot.

B. Qualification Data: For testing agency.

C. Product Test Reports: For each panel ceiling, for tests performed by a qualified testing agency.

D. Evaluation Reports: For each panel ceiling suspension system and anchor and fastener type, from ICC-ES.

E. Field quality-control reports.

#### 1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

#### 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. Wire Grid Ceiling Panel Units: Full-size panels equal to 2 percent of quantity installed.
2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.

#### 1.7 QUALITY ASSURANCE

A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area in location as directed by Architect.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver panels, suspension-system components, and accessories to Project site and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing panels, permit them to reach room temperature and a stabilized moisture content.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install panel ceilings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain each type of metal mesh ceiling panel and its supporting suspension system from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design seismic restraints for ceiling systems.
- B. Seismic Performance: Suspended ceilings shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

#### 2.3 OPEN CELL METAL CEILING PANELS

1. Basis of Design Product: Basis of Design Product: Armstrong World Industries METALWORKS Mesh.
- B. as indicated on Finish Schedule in the Drawings.

1. Provide Basis of Design product or an equivalent product, complying with requirements and approved by Architect prior to bid, by another Manufacturer.
- C. Finish: powder coat.
- D. Color: White.
- E. Ceiling Attenuation Class (CAC): Not less than 35.
- F. Modular Size: 24 by 48 inch cells, as indicated on Drawings.
  1. Wire Thickness: 1/8 inch.

## 2.4 METAL SUSPENSION SYSTEM

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Armstrong World Industries, Inc.
  2. CertainTeed Corp.
  3. Chicago Metallic Corporation.
  4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.
  1. Structural Classification: Heavy-duty system.
  2. End Condition of Cross Runners: Override (stepped) type.
  3. Face Design: Flat, flush.
  4. Cap Material: Steel cold-rolled sheet.
  5. Cap Finish: Painted white.

## 2.5 METAL EDGE MOLDINGS AND TRIM

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Armstrong World Industries, Inc.
  2. CertainTeed Corp.
  3. Chicago Metallic Corporation.
  4. USG Interiors, Inc.; Subsidiary of USG Corporation.
- B. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with

seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

## 2.6 ACCESSORIES

- A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
- B. Wire Hangers, Braces, and Ties: Provide wires as follows:
  1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
  2. Size: Wire diameter sufficient for its stress at three times hanger design load (ASTM C635/C635M, Table 1, "Direct Hung") will be less than yield stress of wire, but not less than 0.135-inch- diameter wire.
- C. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- D. Impact Clips: Manufacturer's standard impact-clip system designed to absorb impact forces against metal mesh panels.
- E. Seismic Clips: Manufacturer's standard seismic clips designed to secure metal mesh panels in place during a seismic event.
- F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of metal mesh panel ceilings.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Measure each ceiling area and establish layout of panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated, and comply with layout shown on reflected ceiling plans.
- B. Layout openings for penetrations centered on the penetrating items.

### 3.3 INSTALLATION

- A. Install panel ceilings according to ASTM C636/C636M, seismic design requirements, and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
  - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
  - 2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
  - 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
  - 4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly to structure or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
  - 5. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
  - 6. Do not attach hangers to steel deck tabs.
  - 7. Do not attach hangers to steel roof deck. Attach hangers to structural members.
  - 8. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
  - 9. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of metal mesh ceiling area and where necessary to conceal edges of metal mesh panels.
  - 1. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends. Miter corners accurately and connect securely.
  - 2. Do not use exposed fasteners, including pop rivets, on moldings and trim.

- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide precise fit.
  - 1. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by metal mesh panel manufacturer.
  - 2. Install impact and seismic clips in areas indicated; space according to panel manufacturer's written instructions unless otherwise indicated.
  - 3. Protect lighting fixtures and air ducts according to requirements indicated for fire-resistance-rated assembly.

### 3.4 ERECTION TOLERANCES

- A. Suspended Ceilings: Install main and cross runners level to a tolerance of 1/8 inch in 12 feet, non-cumulative.

### 3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:
  - 1. Periodic inspection during the installation of suspended ceiling grids according to ASCE/SEI 7.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Perform the following tests and inspections of completed installations of metal mesh panel ceiling hangers and anchors and fasteners in successive stages and when installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed. Do not proceed with installations of metal mesh panel ceiling hangers for the next area until test results for previously completed installations of metal mesh panel ceiling hangers show compliance with requirements.
  - 1. Within each test area, testing agency will select one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and will test them for 200 lbf of tension; it will also select one of every two postinstalled anchors used to attach bracing wires to concrete and will test them for 440 lbf of tension.
  - 2. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Metal mesh panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.6 CLEANING

- A. Clean exposed surfaces of metal mesh panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage.
- B. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5413



## SECTION 09 6513 - RESILIENT BASE AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Resilient base.
  - 2. Resilient molding accessories.
- B. Related Sections:
  - 1. Section 09 6519 "Resilient Tile Flooring" for resilient floor tile.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of product indicated.
- C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.
- D. Product Schedule: For resilient products. Use same designations indicated on Drawings.

#### 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.
- B. Mockups: Provide resilient products with mockups specified in other Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base:
  - 1. Manufacturers: Provide items RB-1, Roppe Pinnacle by Roppe Corporation, USA. as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:
    - a. Flexco, Inc.
    - b. Johnsonite.
    - c. Roppe Corporation, USA.
- B. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TS (rubber, vulcanized thermoset).
  2. Manufacturing Method: Group I (solid, homogeneous).
  3. Style: Cove (base with toe) at solid floors. Straight (flat or toeless) at carpet.
- C. Minimum Thickness: 0.125 inch.
- D. Height: 4 inches.
- E. Lengths: Coils in manufacturer's standard length.
- F. Outside Corners: Preformed.
- G. Inside Corners: Job formed or preformed.
- H. Finish: As selected by Architect from manufacturer's full range.
- I. Colors and Patterns: As indicated on finish schedule. Match Architect's sample.

## 2.2 RESILIENT MOLDING ACCESSORY

- A. Resilient Molding Accessory:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Flexco, Inc.
    - b. Johnsonite.
    - c. Roppe Corporation, USA.
- B. Description: Cap for cove resilient floor covering, Reducer strip for resilient floor covering, Joiner for tile and carpet, nosing for carpeting steps, and transition strips.
- C. Material: Rubber.
- D. Profile and Dimensions: As indicated.
- E. Colors and Patterns: Match Architect's sample.

## 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

- a. Cove Base Adhesives: Not more than 50 g/L.
  - b. Rubber Floor Adhesives: Not more than 60 g/L.
- C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of tiles, and in maximum available lengths to minimize running joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until they are same temperature as the space where they are to be installed.
  - 1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- D. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 RESILIENT BASE INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
  - 1. Inside Corners: Use straight pieces of maximum lengths possible.

### 3.4 RESILIENT ACCESSORY INSTALLATION

- A. Comply with manufacturer's written instructions for installing resilient accessories.
- B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and resilient floor covering that would otherwise be exposed.

### 3.5 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.
- B. Perform the following operations immediately after completing resilient product installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products until Substantial Completion.

END OF SECTION 09 6513

## SECTION 09 6519 - RESILIENT TILE FLOORING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Vinyl composition floor tile.
- B. Related Sections:
  - 1. Section 09 6513 "Resilient Base and Accessories" for resilient base, reducer strips, and other accessories installed with resilient floor coverings.

#### 1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: Full-size units of each color and pattern of floor tile required.
  - 1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
- C. Product Schedule: For floor tile. Use same designations indicated on Drawings.
- D. Qualification Data: For qualified Installer.
- E. Maintenance Data: For each type of floor tile to include in maintenance manuals.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs workers for this Project who are competent in techniques required by manufacturer for floor tile installation and seaming method indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by manufacturer for installation techniques required.

- B. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

- 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

## 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store floor tiles on flat surfaces.

## 1.6 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive floor tile during the following time periods:
  - 1. 48 hours before installation.
  - 2. During installation.
  - 3. 48 hours after installation.
- B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Close spaces to traffic during floor tile installation.
- D. Close spaces to traffic for 48 hours after floor tile installation.
- E. Install floor tile after other finishing operations, including painting, have been completed.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Floor Tile: Furnish 1 box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## PART 2 - PRODUCTS

### 2.1 VINYL COMPOSITION FLOOR TILE

- A. Manufacturers: Provide items VCT-1, VCT-2, VCT-3, VCT-4, VCT-5, VCT-6, and VCT-7, Standard Excelon Imperial Texture by Armstrong, as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:

1. Armstrong.
  2. Johnsonite
  3. Mannington Mills, Inc.
- B. Tile Standard: ASTM F 1066, Class 1, solid-color tile.
- C. Thickness: 0.125 inch.
- D. Size: 12 by 12 inches.
- E. Colors and Patterns: As indicated on Finish Legend on Sheet AF100

## 2.2 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.
1. Use adhesives that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):
    - a. VCT Tile Adhesives: Not more than 50 g/L.
- C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of floor tile.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.
- B. Concrete Substrates: Prepare according to ASTM F 710.



1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
  - a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
  - b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75% relative humidity level measurement.
- C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.
- D. Do not install floor tiles until they are same temperature as space where they are to be installed.
  1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
- E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

### 3.3 FLOOR TILE INSTALLATION

- A. Comply with manufacturer's written instructions for installing floor tile.
- B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  1. Lay tiles square with room axis.
- C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.
  1. Lay tiles with grain running in one direction.
- D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.
- E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.
- G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.
- B. Perform the following operations immediately after completing floor tile installation:
  - 1. Remove adhesive and other blemishes from exposed surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
- C. Protect floor tile products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.
  - 1. Apply two coats.
- E. Sealers and Finish Coats: Remove soil, visible adhesive, and surface blemishes from resilient terrazzo floor tile surfaces before applying liquid cleaners, sealers, and finish products.
  - 1. Sealer: Apply two base coats of liquid sealer.
  - 2. Finish: Apply three coats of liquid floor finish.
- F. Cover floor tile until Substantial Completion.

END OF SECTION 09 6519

## SECTION 09 6543 - LINOLEUM FLOORING

### PART 1 - GENERAL

#### 1.1 SUMMARY

A. Section Includes:

1. Linoleum flooring.

#### 1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For linoleum flooring.

1. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
2. Show details of special patterns.

C. Samples for Verification: For each type of linoleum flooring, in manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern required.

D. Product Schedule: For linoleum flooring. Use same designations indicated on Drawings.

#### 1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

#### 1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of linoleum flooring to include in maintenance manuals.

#### 1.5 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. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

## 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for flooring installation and seaming methods indicated.
  - 1. Engage an installer who employs workers for this Project who are trained or certified by flooring manufacturer for installation techniques required.
    - a. Contact manufacturer's rep Julie Jones for additional information and guidance. [Julie.jones@forbo.com](mailto:Julie.jones@forbo.com); 801-209-8143.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
  - 1. Coordinate mockups in this Section with mockups specified in other Sections.
    - a. Size: Minimum 100 sq. ft. for each type, color, and pattern in locations directed by Architect.
  - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  - 3. Install Mockup in presence of a senior technical installation representative from flooring manufacturer. The senior technical installation representative shall be on site to witness and comment on the seaming and installation procedures.
  - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

## 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.
  - 1. Floor Tile: Store on flat surfaces.

## 1.8 PROJECT CONDITIONS

- A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive flooring during the following periods:
  - 1. 72 hours before installation.
  - 2. During installation.
  - 3. 72 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

- C. Close spaces to traffic during flooring installation.
- D. Close spaces to traffic for 72 hours after flooring installation.
- E. Install flooring after other finishing operations, including painting, have been completed.

## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.
  - 1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

### 2.2 LINOLEUM TILE FLOORING

- A. Basis of Design Products: Subject to compliance with requirements, provide items indicated on Finish Schedule in Drawings, or equivalent products approved by Architect prior to bid, by another manufacturer.
- B. Linoleum Tile Flooring: ASTM F2034.
- C. Sheet Flooring Type LF-1:
  - 1. Basis of Design: Item (Forbo Industries, Inc; Marmoleum Marble –COLOR TBD) or as indicated on Finish Legend.
  - 2. Tile size: Sheet Good, as indicated on Finish Legend, .
- D. Thickness: 0.10 inch.
- E. Colors and Patterns: As indicated on Finish Schedule in Drawings.

### 2.3 INSTALLATION MATERIALS

- A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by linoleum flooring manufacturer for applications indicated.
- B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.
  - 1. Adhesives shall have a VOC content of 50 g/L or less.
- C. Floor Polish: Provide protective, liquid floor-polish products recommended by linoleum flooring manufacturer.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
  - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of flooring. Contact Manufacturer's rep to ensure that substrates are in compliance with Manufacturer's standards.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 PREPARATION

- A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.
- B. Seaming Plan Approval for Sheet Flooring: Obtain Architect's approval of sheet flooring seaming plan prior to installation of sheet flooring.
  - 1. Do not place seams at middles of corridors and avoid cross seams.
- C. Concrete Substrates: Prepare according to ASTM F710.
  - 1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
  - 2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
- D. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- E. Do not install flooring until materials are the same temperature as space where they are to be installed.
  - 1. At least 72 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.
- F. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

#### 3.3 INSTALLATION, GENERAL

- A. Comply with manufacturer's written instructions for installing flooring.

- B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, thresholds, door frames, and nosings.
- C. Extend flooring into toe spaces, door reveals, closets, and similar openings.
- D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.
- E. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

### 3.4 LINOLEUM SHEET FLOORING INSTALLATION

### 3.5 LINOLEUM FLOOR TILE INSTALLATION

- A. Lay out linoleum floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.
  - 1. Lay floor tiles in pattern indicated.
- B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.
  - 1. Lay floor tiles in pattern of colors and sizes indicated.

### 3.6 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.
- B. Perform the following operations immediately after completing linoleum flooring installation:
  - 1. Remove adhesive and other blemishes from surfaces.
  - 2. Sweep and vacuum surfaces thoroughly.
  - 3. Damp-mop surfaces to remove marks and soil.
    - a. Do not wash floor coverings for 72 hours after installation.
- C. Protect floor coverings against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods indicated or recommended in writing by manufacturer.

1. Cover linoleum floor coverings with undyed, untreated building paper until inspection for Substantial Completion. If using tape to adhere building paper, please test prior to ensure that Tape residue will not damage the factory applied Top Shield.
  - a. Allow drying room film (yellow film caused by linseed oil oxidation) to disappear before Substantial Completion.
2. Do not move heavy and sharp objects directly over floor covering surfaces. Place plywood or hardboard panels over floor coverings and under objects while they are being moved. Slide or roll objects over panels without moving panels.

END OF SECTION 09 6543



## SECTION 09 6813 - TILE CARPETING

### 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 the following:
  - 1. Modular, carpet tile.
- B. Related Requirements:
  - 1. Section 09 6513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.
  - 2. Section 09 6816 "Sheet Carpeting."

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
    - a. Review delivery, storage, and handling procedures.
    - b. Review ambient conditions and ventilation procedures.
    - c. Review subfloor preparation procedures.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
  - 2. Include installation recommendations for each type of substrate.
- B. Shop Drawings: Show the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.

2. Carpet tile type, color, and dye lot.
  3. Type of subfloor.
  4. Type of installation.
  5. Pattern of installation.
  6. Pattern type, location, and direction.
  7. Pile direction.
  8. Type, color, and location of insets and borders.
  9. Type, color, and location of edge, transition, and other accessory strips.
  10. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet Tile: Full-size Sample.
  2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.
- D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.
- C. Sample Warranty: For special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

#### 1.7 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. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
- B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockups at locations and in sizes shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

1.11 WARRANTY

- A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
  - 3. Warranty Period: 10 years from date of Substantial Completion.
- B. Special Warranty for StepUp Walk-off Carpet Tiles: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, zippering, adhesive bond with manufacturer's adhesive, excess static discharge, and delamination.
3. Warranty Period: Lifetime of carpet.

## PART 2 - PRODUCTS

### 2.1 CARPET TILE

- A. Manufacturers: Provide item CPT-1 Zip It GT296 by Mohawk Group as indicated on Finish Legend on Sheet A601 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer.
  1. Tufted.
  2. Color: As indicated on Finish legend and matching Architect's samples.
  3. Stitches: 11 stitches per inch.
  4. Pattern: Match Architect's samples.
  5. Fiber Type: Duracolor® Premium Nylon
  6. Pile Characteristic: Textured pattern loop.
  7. Density: 7,043 oz./cu. yd.
  8. Gage: 1/12.
  9. Pile Thickness: 0.92 inches for finished carpet tile.
  10. Primary Backing/Backcoating: EcoFlex NXT, or manufacturer's equivalent.
  11. Size: 12 by 36 inches.
  12. Applied Soil-Resistance Treatment: Manufacturer's standard material.
  13. Antimicrobial Treatment: Manufacturer's standard material.
  14. Installation: Herringbone.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
  1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.

2. Subfloor finishes comply with requirements specified in Division 03 Section "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

### 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 6.2, "Site Conditions; Floor Preparation," and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.
- D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.
- E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

### 3.3 INSTALLATION

- A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.
- B. Installation Method: As recommended in writing by carpet tile manufacturer.
- C. Maintain dye lot integrity. Do not mix dye lots in same area.
- D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.
- E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.
- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders.

- H. Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

### 3.4 CLEANING AND PROTECTION

- A. Perform the following operations immediately after installing carpet tile:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
  - 2. Remove yarns that protrude from carpet tile surface.
  - 3. Vacuum carpet tile using commercial machine with face-beater element.
- B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 6813

## SECTION 09 6816 - SHEET CARPETING

### 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:
- B. Related Requirements:
  - 1. Section 09 6813 "Tile Carpeting."

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
  - 1. Review methods and procedures related to carpet installation including, but not limited to, the following:
    - a. Review delivery, storage, and handling procedures.
    - b. Review ambient conditions and ventilation procedures.
    - c. Review subfloor preparation procedures.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For the following, including installation recommendations for each type of substrate:
  - 1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
- B. Shop Drawings: Show the following:
  - 1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
  - 2. Carpet type, color, and dye lot.
  - 3. Locations where dye lot changes occur.
  - 4. Seam locations, types, and methods.
  - 5. Type of subfloor.

6. Type of installation.
  7. Pattern type, repeat size, location, direction, and starting point.
  8. Pile direction.
  9. Type, color, and location of insets and borders.
  10. Type, color, and location of edge, transition, and other accessory strips.
  11. Transition details to other flooring materials.
- C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
1. Carpet: 12-inch- square Sample.
  2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.
  3. Carpet Seam: 6-inch Sample.
  4. Mitered Carpet Border Seam: 12-inch- square Sample. Show carpet pattern alignment.
- D. Product Schedule: For carpet. Use same designations indicated on Drawings.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Product Test Reports: For carpet, for tests performed by a qualified testing agency.
- C. Sample Warranties: For special warranties.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
  2. Precautions for cleaning materials and methods that could be detrimental to carpet.

#### 1.7 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. Carpet: Full-width rolls equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.



- B. Fire-Test-Response Ratings: Where indicated, provide carpet identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
  - 1. Build mockups at locations and in sizes shown on Drawings.
  - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with CRI 104.

#### 1.10 FIELD CONDITIONS

- A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
- B. Environmental Limitations: Do not deliver or install carpet until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
- C. Do not install carpet over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.
- D. Where demountable partitions or other items are indicated for installation on top of carpet, install carpet before installing these items.

#### 1.11 WARRANTY

- A. Special Warranty for Carpet: Manufacturer agrees to repair or replace components of carpet installation that fail in materials or workmanship within specified warranty period.
  - 1. Warranty does not include deterioration or failure of carpet due to unusual traffic, failure of substrate, vandalism, or abuse.
  - 2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
  - 3. Warranty Period: 10 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 CARPET

- A. Manufacturers: Provide item CPT-9 by Mohawk Group as indicated on Finish Legend on Sheet A601 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer.
- B. Color: As indicated on Finish Legend on Sheet A601.
- C. Pattern: Match Architect's samples.
- D. Applied Soil-Resistance Treatment: Manufacturer's standard material.
- E. Antimicrobial Treatment: Manufacturer's standard material.
- F. Installation: Stepped up floor in Choral Room.

### 2.2 INSTALLATION ACCESSORIES

- A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet cushion manufacturer.
- B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
- C. Seam Adhesive: Hot-melt adhesive tape or similar product recommended by carpet manufacturer for sealing and taping seams and butting cut edges at backing to form secure seams and to prevent pile loss at seams.
- D. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.
- B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet cushion manufacturer.
  2. Subfloor finishes comply with requirements specified in Section 03 3000 "Cast-in-Place Concrete" for slabs receiving carpet.
  3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. General: Comply with CRI 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.
- B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer's written instructions.
- C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet cushion manufacturer.
- D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

### 3.3 INSTALLATION

- A. Comply with CRI 104 and carpet manufacturer's written installation instructions for the following:
  1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."
- B. Comply with carpet manufacturer's written recommendations and Shop Drawings for seam locations and direction of carpet; maintain uniformity of carpet direction and lay of pile. At doorways, center seams under the door in closed position.
- C. Do not bridge building expansion joints with carpet.
- D. Cut and fit carpet to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet manufacturer.
- E. Extend carpet into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

- F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.
- G. Install pattern parallel to walls and borders to comply with CRI 104, Section 15, "Patterned Carpet Installations" and with carpet manufacturer's written recommendations.

### 3.4 CLEANING AND PROTECTING

- A. Perform the following operations immediately after installing carpet:
  - 1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
  - 2. Remove yarns that protrude from carpet surface.
  - 3. Vacuum carpet using commercial machine with face-beater element.
- B. Protect installed carpet to comply with CRI 104, Section 16, "Protecting Indoor Installations."
- C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer and carpet adhesive manufacturer.

END OF SECTION 09 6816

**SECTION 09 84 00**  
**One-Dimensional Quadratic Residue Diffuser (2" GUD PANEL)**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this Section 06420 – Wood Paneling
- B. Section 09120 – Suspension Framing/Furring for Plaster/Gypsum Board Assemblies
- C. Section 091000 – Gypsum Board
- D. Division 15 Sections – Mechanical Work
- E. Division 16 Sections – Electrical Work
- F. Division 17 Sections – Audio, Data, Telecommunication Work

**1.2 SUMMARY**

- A. Section Includes: [description]

**1.3 REFERENCES**

- A. American Society for Testing & Materials (ASTM) International:
  - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - 2. ISO 17497-1 and ISO 17497-2 Standard Test Methods for diffusion and scattering of acoustic materials and proposed ASTM Standard Test Method for Testing the Reflectivity of Surfaces
  - 3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Material

**1.4 SYSTEM DESCRIPTION**

- B. One-Dimensional Quadratic Residue Diffusers are standalone units that may be used singly or in multiples featuring prime numbers of not less than 11 and with full sequences (0-0) that do not require special coupling or custom units for centers and ends.
- C. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum
    - b. Smoke Developed: 1000 maximum
    - c. Fire ratings for all wood products shall meet or exceed ASTM E84 Class "A" standards.

**1.5 SUBMITTALS**

- A. General: Submit listed submittals in accordance with the following:
  - 1. Division 00: Procurement and Contracting Requirements
  - 2. Division 01 General Requirements
- B. Product Data: Submit product data sheet, for specified products
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including mounting, hardware and finishes and/or other materials
- D. Samples: Submit selection and verification samples of finishes, colors and textures. Samples shall be a minimum of 10"x10"
- E. Test Reports: Certified test reports showings compliance with specified performance requirements. All acoustic absorption tests shall be verified utilizing either ASTM C423 or ISO 354 absorption standards. All diffusion and/or scattering test data shall be, at minimum, ISO 17497-1 and/or ISO 17947-2 (AES 4-id) or ASTM Proposed Test Method for Testing the Reflectivity of Surfaces. ASTM E84 standard test method for flame and smoke spread (fire test). All test data must be modeled and performed on full-size products to ensure the accuracy of results.

## 1.6 QUALITY ASSURANCE

Specifier Note: Manufacturers and installers shall have a minimum 5 years of experience in the manufacturing and/or installation of the materials specified in this document. All wood products shall be manufactured utilizing AWI standards and practices.

## 1.7 DELIVERY, STORAGE, & HANDLING

- A. General: Comply with Division 01 Product Requirements Section
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions as listed in section 1.8.

## 1.8 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature, as well as the relative humidity, are stabilized at 55 – 75 degrees F (16 – 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood, MDF, or other wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize. Environmental Standards shall meet or exceed the requirements as issued by the Architectural Woodwork Institute.

## 1.9 MOCKUP

- A. Panel mockup may be provided at the request of the general contractor or architect

## 1.10 WARRANTY

- A. Refer to manufacturer for details on warranty

## PART 2 – PRODUCTS

### 2.1 PRODUCT: Geometric Uniform Diffuser (GUD PANEL) Quadratic Residue Diffuser

- A. Manufacturer: RealAcoustix LLC. (Basis of Design)
  - 1. Contact: 2361 B Avenue, Ogden, UT 84401; Phone: (801) 782-1010; Email: [Info@RealAcoustix.com](mailto:Info@RealAcoustix.com); Site: <http://www.realacoustix.com/>
- B. Substitutions: No substitutions permitted

### 2.2 MATERIALS

- A. Core (Standard): MDF with finished veneers.
- B. Veneers: Natural wood veneer, species and cut (Maple/Plain-sliced) Plastic Laminate (Manufacturer)

### 2.3 MANUFACTURED UNITS

- A. PRODUCT NAME: Geometric Uniform Diffuser (GuD Panel)
  - 1. Thickness: 2"
  - 2. Size: Standard: 23 5/8" x 23 5/8", 47 1/4" x 23 5/8", Custom Sizes: See drawings
  - 3. Core: MDF & GFRG
  - 4. Edge Detail: Squared
  - 5. Face: Multi-cell surface with finished cells of different depths based on the Schroeder quadratic residue equation.
  - 6. Test Data: See below.
  - 7. Mounting Hardware: [Z-Clip & Z-Bar] [Other: Specify]

### 2.4 TEST DATA

See Following Page:

## 2.4 TEST DATA

### ISO 17497-1

Frequency	Absorption Coefficient	Scattering Coefficient
100Hz	0.04	0.00
125Hz	0.07	0.00
160Hz	0.00	0.00
200Hz	0.00	0.00
250Hz	0.01	0.02
315Hz	0.10	0.03
400Hz	0.09	0.04
500Hz	0.07	0.08
630Hz	0.15	0.18
800Hz	0.13	0.20
1000Hz	0.17	0.44
1250Hz	0.25	0.70
1600Hz	0.33	1.40
2000Hz	0.44	1.88
2500Hz	0.41	2.02
3150Hz	0.43	2.48
4000Hz	0.58	2.74
5000Hz	0.76	2.76
6300Hz	0.92	2.83
8000Hz	0.96	2.79
10000Hz	0.86	2.68

## 2.5 FABRICATION

- A. GuD Panel Quadratic Residue Diffusers are CNC cut with a minimum of .01 tolerance standard for all parts. All assembly is done by qualified factory staff. All units are mounted standard by Z-clip/Z-bar per instructions

## 2.6 FINISHES

- A. Shop Finishing: Panels shall be shop-finished with clear pre-catalyzed lacquer finish system or water-based lacquer depending on the wood species and specifications unless plastic laminates or fabrics are utilized.

## PART 3 – EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation, instructions and product carton instructions for installation

### 3.2 EXAMINATION

- A. Site Verification and Conditions: Please refer to section 1.8
- B. Site Verification of Condition: Examine installation area for compliance with all manufacturer's project environmental requirements and ensure uninstalled products have been stored, handled and acclimatized properly prior to commencing installation. Inspect all substrates for completion and quality of work to ensure that surfaces are level, plumb, clean, dry, and

completely cured from water or solvent evaporation. Do not commence installation if the structural capacity of the substrate is questionable or inadequate.

- C. Coordination with Other Trades: Coordinate with all other trades to ensure that wet work including concrete, terrazzo, plastering, painting, etc. in the installation area is complete, cured and dry prior to installation. Coordinate with all other trades to verify that components associated with mechanical, electrical, lighting, data, telecommunication, audio, video, fire suppression and other building systems are installed behind or above designated installation areas prior to commencing

- D. installation. Coordinate the exact size, location and sequencing of building system components that penetrate the wood ceiling/wall panels.

### 3.3 PREPARATION

- A. Protection: Protect all floor, wall and ceiling finishes against possible damage prior to commencing installation and during installation
- B. Surface Preparation: When necessary, field measure substrates to acquire accurate dimensions of acoustical panels and submit final dimensions to manufacturer

### 3.4 INSTALLATION

- A. Install acoustical panels as shown and detailed in the architectural drawings, shop drawings (manufacturer provided) and according to manufacturer's guidelines and industry standards
- B. Install acoustical panels with expansion/contraction gaps appropriate for the project and as identified in the submittal documentation

### 3.5 CONSTRUCTION

- A. Interface with Other Work: Support all light fixtures, HVAC air inlet/outlet devices, speakers, signage, sprinkler heads/piping, etc. independently from acoustical panels. Contractor shall not use acoustical panels to support the weight of any other building element or component.

### 3.6 ADJUSTING

- A. Following initial installation, adjust mounting hardware or suspension system so that removable panels can be removed easily, yet stay safely secured upon replacement. Adjust panels so that surfaces are aligned, flush and level or plumb and gaps in between units are of a consistent width and straight.
- B. Check that manufacturer's expansion/contraction requirements were maintained during installation. As required, adjust the mounting hardware or suspension system to allow for the appropriate amount of product expansion/contraction.
- C. Remove and replace any damaged panels that cannot be repaired to the Owner's and Architect's satisfaction.

### 3.7 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris

### 3.8 DEMONSTRATION

- A. Demonstrate to the building owner or to the owner's representative the safe and proper method for removing and replacing all types of accessible panels
- B. Supply the building owner or the owner's representative with any special tools provided by the manufacturer required to unlatch safety hardware on accessible panels

### 3.9 PROTECTION

- A. Upon completion of work, protect installed acoustical surfaces from damage or soiling until project substantial completion and owner occupancy

**END OF SECTION**



**SECTION 09 84 00**  
**One-Dimensional Quadratic Residue Diffuser (RQS450)**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this Section 06420 – Wood Paneling
- B. Section 09120 – Suspension Framing/Furring for Plaster/Gypsum Board Assemblies
- C. Section 09450 – Gypsum Board
- D. Division 15 Sections – Mechanical Work
- E. Division 16 Sections – Electrical Work
- F. Division 17 Sections – Audio, Data, Telecommunication Work

**1.2 SUMMARY**

- A. Section Includes: [description]

**1.3 REFERENCES**

- A. American Society for Testing & Materials (ASTM) International:
  - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - 2. ISO 17497-1 and ISO 17497-2 Standard Test Methods for diffusion and scattering of acoustic materials and proposed ASTM Standard Test Method for Testing the Reflectivity of Surfaces
  - 3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Material

**1.4 SYSTEM DESCRIPTION**

- B. One-Dimensional Quadratic Residue Diffusers are standalone units that may be used singly or in multiples featuring prime numbers of not less than 11 and with full sequences (0-0) that do not require special coupling or custom units for centers and ends.
- C. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum
    - b. Smoke Developed: 450 maximum
    - c. Fire ratings for all wood products shall meet or exceed ASTM E84 Class "A" standards.

**1.5 SUBMITTALS**

- A. General: Submit listed submittals in accordance with the following:
  - 1. Division 00: Procurement and Contracting Requirements
  - 2. Division 01 General Requirements
- B. Product Data: Submit product data sheet, for specified products
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including mounting, hardware and finishes and/or other materials
- D. Samples: Submit selection and verification samples of finishes, colors and textures. Samples shall be a minimum of 10"x10"
- E. Test Reports: Certified test reports showings compliance with specified performance requirements. All acoustic absorption tests shall be verified utilizing either ASTM C423 or ISO 354 absorption standards. All diffusion and/or scattering test data shall be, at minimum, ISO 17497-1 and/or ISO 17947-2 (AES 4-id) or ASTM Proposed Test Method for Testing the Reflectivity of Surfaces. ASTM E84 standard test method for flame and smoke spread (fire test). All test data must be modeled and performed on full-size products to ensure the accuracy of results.

## 1.6 QUALITY ASSURANCE

Specifier Note: Manufacturers and installers shall have a minimum 5 years of experience in the manufacturing and/or installation of the materials specified in this document. All wood products shall be manufactured utilizing AWI standards and practices.

## 1.7 DELIVERY, STORAGE, & HANDLING

- A. General: Comply with Division 01 Product Requirements Section
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions as listed in section 1.8.

## 1.8 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature, as well as the relative humidity, are stabilized at 55 – 75 degrees F (16 – 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood, MDF, or other wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize. Environmental Standards shall meet or exceed the requirements as issued by the Architectural Woodwork Institute.

## 1.9 MOCKUP

- A. Panel mockup may be provided at the request of the general contractor or architect

## 1.10 WARRANTY

- A. Refer to manufacturer for details on warranty

## PART 2 – PRODUCTS

### 2.1 PRODUCT: RealQuad Studio450 (RQS450) Quadratic Residue Diffuser

- A. Manufacturer: RealAcoustix LLC. (Basis of Design)
  - 1. Contact: 2361 B Avenue, Ogden, UT 84401; Phone: (801) 782-1010; Email: [Info@RealAcoustix.com](mailto:Info@RealAcoustix.com); Site: <http://www.realacoustix.com/>
- B. Substitutions: No substitutions permitted

### 2.2 MATERIALS

- A. Core (Standard): MDF with finished veneers.
- B. Veneers: Natural wood veneer, species and cut (Maple/Plain-sliced) Plastic Laminate (Manufacturer)

### 2.3 MANUFACTURED UNITS

- A. PRODUCT NAME: RealQuad Studio 450
  - 1. Thickness: 7 7/8"
  - 2. Size: Standard: 23 5/8" x 23 5/8", 47 1/4" x 23 5/8", 60" x 23 5/8" and 72" x 23 5/8". Custom Sizes: See drawings
  - 3. Core: MDF
  - 4. Edge Detail: Squared
  - 5. Face: Multi-cell surface with finished cells of different depths based on the Schroeder quadratic residue equation.
  - 6. Test Data: See below.
  - 7. Mounting Hardware: [Z-Clip & Z-Bar] [Other: Specify]

### 2.4 TEST DATA

See Following Page:

## 2.4 TEST DATA

Frequency [Hz]	Scattering Coefficient	Normalized Diffusion Coefficient	Diffusion Coefficient
100	0.011	0.052	0.667
125	0.017	0.081	0.669
160	0.028	0.121	0.671
200	0.044	0.172	0.668
250	0.073	0.207	0.649
315	0.175	0.160	0.578
400	0.658	0.893	0.940
500	0.311	0.379	0.621
630	0.948	0.523	0.692
800	0.806	0.563	0.700
1000	0.355	0.425	0.584
1250	0.973	0.571	0.673
1600	0.945	0.398	0.518
2000	0.652	0.431	0.524
2500	0.951	0.411	0.488
3150	0.987	0.359	0.427
4000	0.643	0.342	0.398
5000	0.992	0.311	0.357
6300	0.949	0.417	0.447

## 2.5 FABRICATION

- A. RealQuad Audio Quadratic Residue Diffusers are CNC-machined with a minimum of .01 tolerance standard for all parts. All assembly is done by qualified factory staff. All units are mounted standard by Z-clip/Z-bar per instructions.

## 2.6 FINISHES

- A. Shop Finishing: Panels shall be shop-finished with clear pre-catalyzed lacquer finish system or water-based lacquer depending on the wood species and specifications unless plastic laminates or fabrics are utilized.

## PART 3 – EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

### 3.2 EXAMINATION

- A. Site Verification and Conditions: Please refer to section 1.8
- B. Site Verification of Condition: Examine installation area for compliance with all manufacturer's project environmental requirements and ensure uninstalled products have been stored, handled and acclimatized properly prior to commencing installation. Inspect all substrates for completion and quality of work to ensure that surfaces are level, plumb, clean, dry, and completely cured from water or solvent evaporation. Do not commence installation if the structural capacity of the substrate is questionable or inadequate.
- C. Coordination with Other Trades: Coordinate with all other trades to ensure that wet work including concrete, terrazzo, plastering, painting, etc. in the installation area is complete, cured and dry prior to installation. Coordinate with all other trades to verify that components associated with mechanical, electrical, lighting, data, telecommunication, audio, video, fire suppression and other building systems are installed behind or above designated installation areas prior to commencing

- D. installation. Coordinate the exact size, location and sequencing of building system components that penetrate the wood ceiling/wall panels.

### 3.3 PREPARATION

- A. Protection: Protect all floor, wall and ceiling finishes against possible damage prior to commencing installation and during installation
- B. Surface Preparation: When necessary, field measure substrates to acquire accurate dimensions of acoustic panels and submit final dimensions to manufacturer

**3.4 INSTALLATION**

- A. Install acoustical panels as shown and detailed in the architectural drawings, shop drawings (manufacturer provided) and according to manufacturer's guidelines and industry standards
- B. Install acoustical panels with expansion/contraction gaps appropriate for the project and as identified in the submittal documentation

**3.5 CONSTRUCTION**

- A. Interface with Other Work: Support all light fixtures, HVAC air inlet/outlet devices, speakers, signage, sprinkler heads/piping, etc. independently from acoustical panels. Contractor shall not use acoustical panels to support the weight of any other building element or component.

**3.6 ADJUSTING**

- A. Following initial installation, adjust mounting hardware or suspension system so that removable panels can be removed easily, yet stay safely secured upon replacement. Adjust panels so that surfaces are aligned, flush and level or plumb and gaps in between units are of a consistent width and straight.
- B. Check that manufacturer's expansion/contraction requirements were maintained during installation. As required, adjust the mounting hardware or suspension system to allow for the appropriate amount of product expansion/contraction.
- C. Remove and replace any damaged panels that cannot be repaired to the Owner's and Architect's satisfaction.

**3.7 CLEANING**

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris

**3.8 DEMONSTRATION**

- A. Demonstrate to the building owner or to the owner's representative the safe and proper method for removing and replacing all types of accessible panels
- B. Supply the building owner or the owner's representative with any special tools provided by the manufacturer required to unlatch safety hardware on accessible panels

**3.9 PROTECTION**

- A. Upon completion of work, protect installed acoustical surfaces from damage or soiling until project substantial completion and owner occupancy

**END OF SECTION**

**SECTION 09 84 00**  
**Mono Wave Ceiling or Wall Redirector (WaveMC)**

**PART 1 – GENERAL**

**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specifications Sections, apply to this Section 06420 – Wood Paneling
- B. Section 09120 – Suspension Framing/Furring for Plaster/Gypsum Board Assemblies
- C. Section 09250 – Gypsum Board
- D. Division 15 Sections – Mechanical Work
- E. Division 16 Sections – Electrical Work
- F. Division 17 Sections – Audio, Data, Telecommunication Work

**1.2 SUMMARY**

- A. Section Includes: Mono-wave ceiling or wall redirector / WaveMC

**1.3 REFERENCES**

- A. American Society for Testing & Materials (ASTM) International:
  - 1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
  - 2. ISO 17497-1 and ISO 17497-2 Standard Test Methods for diffusion and scattering of acoustic materials and proposed ASTM Standard Test Method for Testing the Reflectivity of Surfaces
  - 3. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Material

**1.4 SYSTEM DESCRIPTION**

- B. S are standalone units that may be used singly or in multiples featuring prime numbers of not less than 11 and with full sequences (0-0) that do not require special coupling or custom units for centers and ends.
- C. Performance Requirements:
  - 1. Surface Burning Characteristics (ASTM E84):
    - a. Flamespread: 25 maximum
    - b. Smoke Developed: 450 maximum
    - c. Fire ratings for all wood products shall meet or exceed ASTM E84 Class "A" standards.

**1.5 SUBMITTALS**

- A. General: Submit listed submittals in accordance with the following:
  - 1. Division 00: Procurement and Contracting Requirements
  - 2. Division 01 General Requirements
- B. Product Data: Submit product data sheet, for specified products
- C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including mounting, hardware and finishes and/or other materials
- D. Samples: Submit selection and verification samples of finishes, colors and textures. Samples shall be a minimum of 10"x10"
- E. Test Reports: Certified test reports showings compliance with specified performance requirements. All acoustic absorption tests shall be verified utilizing either ASTM C423 or ISO 354 absorption standards. All diffusion and/or scattering test data shall be, at minimum, ISO 17497-1 and/or ISO 17947-2 (AES 4-id) or ASTM Proposed Test Method for Testing the Reflectivity of Surfaces. ASTM E84 standard test method for flame and smoke spread (fire test). All test data must be modeled and performed on full-size products to ensure the accuracy of results.

## 1.6 QUALITY ASSURANCE

Specifier Note: Manufacturers and installers shall have a minimum 5 years of experience in the manufacturing and/or installation of the materials specified in this document. All wood products shall be manufactured utilizing AWI standards and practices.

## 1.7 DELIVERY, STORAGE, & HANDLING

- A. General: Comply with Division 01 Product Requirements Section
- B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact
- C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions as listed in section 1.8.

## 1.8 PROJECT CONDITIONS

- A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature, as well as the relative humidity, are stabilized at 55 – 75 degrees F (16 – 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood, MDF, or other wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize. Environmental Standards shall meet or exceed the requirements as issued by the Architectural Woodwork Institute.

## 1.9 MOCKUP

- A. Panel mockup may be provided at the request of the general contractor or architect

## 1.10 WARRANTY

- A. Refer to manufacturer for details on warranty

## PART 2 – PRODUCTS

2.1 PRODUCT: Basis of Design Products: Mono-wave Cloud (WAVEMC) Redirector/Diffuser subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturers

- A. Manufacturer: RealAcoustix LLC. (Basis of Design)
  - 1. Contact: 2361 B Avenue, Ogden, UT 84401; Phone: (801) 782-1010; Email: [Info@RealAcoustix.com](mailto:Info@RealAcoustix.com); Site: <http://www.realacoustix.com/>
- B. Substitutions: No substitutions permitted

## 2.2 MATERIALS

- A. Core (Standard): MDF with finished veneers.
- B. Acoustic Insulation: 6 pcf density fiberglass board required as backing substrate to maintain test specifications (provided by others)

## 2.3 MANUFACTURED UNITS

- A. PRODUCT NAME: WaveMC
  - 1. Thickness: Varies by design
  - 2. Size: Standard: 97 ¼" W x 47 ¼" (Custom Size):
  - 3. Core: Birch Plywood
  - 4. Edge Detail: Squared
  - 5. Face: Cloud with single curve at design height
  - 6. Test Data: See below.
  - 7. Mounting Hardware: [Cleat mount] [Cable Hang] [Other: Specify]

## 2.4 TEST DATA

See Following Page:

## 2.4 TEST DATA

Frequency [Hz]	Scattering Coefficient	Normalized Diffusion Coefficient	Diffusion Coefficient
100	0.076	0.120	0.499
125	0.085	0.119	0.460
160	0.106	0.149	0.447
200	0.142	0.179	0.433
250	0.183	0.211	0.427
315	0.250	0.248	0.425
400	0.360	0.293	0.433
500	0.516	0.331	0.438
630	0.693	0.345	0.430
800	0.853	0.371	0.436
1000	0.911	0.392	0.442
1250	0.873	0.402	0.442
1600	0.894	0.411	0.441
2000	0.950	0.423	0.446
2500	0.934	0.429	0.447
3150	0.959	0.435	0.449
4000	0.972	0.440	0.450

## 2.5 FABRICATION

- A. RealAcoustix Wave Products are CNC cut with a minimum of .01 tolerance standard for all parts. All assembly is done by qualified factory staff. All units are mounted standard by cables or cleats per instructions

## 2.6 FINISHES

- A. Shop Finishing: Panels shall be shop-finished with clear pre-catalyzed lacquer finish system or water-based lacquer depending on the wood species and specifications unless plastic laminates or fabrics are utilized.

## PART 3 – EXECUTION

### 3.1 MANUFACTURER'S INSTRUCTIONS

- A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation, instructions and product carton instructions for installation

### 3.2 EXAMINATION

- A. Site Verification and Conditions: Please refer to section 1.8
- B. Site Verification of Condition: Examine installation area for compliance with all manufacturer's project environmental requirements and ensure uninstalled products have been stored, handled and acclimatized properly prior to commencing installation. Inspect all substrates for completion and quality of work to ensure that surfaces are level, plumb, clean, dry, and completely cured from water or solvent evaporation. Do not commence installation if the structural capacity of the substrate is questionable or inadequate.
- C. Coordination with Other Trades: Coordinate with all other trades to ensure that wet work including concrete, terrazzo, plastering, painting, etc. in the installation area is complete, cured and dry prior to installation. Coordinate with all other trades to verify that components associated with mechanical, electrical, lighting, data,

telecommunication, audio, video, fire suppression and other building systems are installed behind or above designated installation areas prior to commencing installation. Coordinate the exact size, location and sequencing of building system components that penetrate the wood ceiling/wall panels.

### 3.3 PREPARATION

- A. Protection: Protect all floor, wall and ceiling finishes against possible damage prior to commencing installation and during installation
- B. Surface Preparation: When necessary, field measure substrates to acquire accurate dimensions of acoustical panels and submit final dimensions to manufacturer

### 3.4 INSTALLATION

- A. Install acoustical panels as shown and detailed in the architectural drawings, shop drawings (manufacturer provided) and according to manufacturer's guidelines and industry standards
- B. Install acoustical panels with expansion/contraction gaps appropriate for the project and as identified in the submittal documentation

### 3.5 CONSTRUCTION

- A. Interface with Other Work: Support all light fixtures, HVAC air inlet/outlet devices, speakers, signage, sprinkler heads/piping, etc. independently from acoustical panels. Contractor shall not use acoustical panels to support the weight of any other building element or component.

### 3.6 ADJUSTING

- A. Following initial installation, adjust mounting hardware or suspension system so that removable panels can be removed easily, yet stay safely secured upon replacement. Adjust panels so that surfaces are aligned, flush and level or plumb and gaps in between units are of a consistent width and straight.
- B. Check that manufacturer's expansion/contraction requirements were maintained during installation. As required, adjust the mounting hardware or suspension system to allow for the appropriate amount of product expansion/contraction.
- C. Remove and replace any damaged panels that cannot be repaired to the Owner's and Architect's satisfaction.

### 3.7 CLEANING

- A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.
- B. Keep site free from accumulation of waste and debris

### 3.8 DEMONSTRATION

- A. Demonstrate to the building owner or to the owner's representative the safe and proper method for removing and replacing all types of accessible panels
- B. Supply the building owner or the owner's representative with any special tools provided by the manufacturer required to unlatch safety hardware on accessible panels

### 3.9 PROTECTION

- A. Upon completion of work, protect installed acoustical surfaces from damage or soiling until project substantial completion and owner occupancy

## END OF SECTION



## SECTION 09 8433 - SOUND-ABSORBING WALL UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
  - 1. Fabric wrapped sound-absorbing wall panels.
  - 2. Sound-absorbing polyester felt wall panels.
  - 3. Tectum sound-absorbing wall panels.

#### 1.3 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.

#### 1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of fabric facing, panel edge, core material, and mounting indicated.
- B. Shop Drawings: For sound-absorbing wall units. Include mounting devices and details; details at panel head, base, joints, and corners; and details at ceiling, floor base, and wall intersections. Indicate panel edge and core materials.
  - 1. Include elevations showing panel sizes and direction of fabric weave and pattern matching.
- C. Samples for Verification: For the following products, prepared on Samples of size indicated below:
  - 1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
  - 2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.

3. Core Material: 12-inch- square Sample at corner.
4. Mounting Devices: Full-size Samples.
5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Elevations and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  1. Electrical outlets, switches, and thermostats.
  2. Items penetrating or covered by sound-absorbing wall units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Access panels.
  3. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing wall units.
- B. Product Certificates: For each type of sound-absorbing wall unit, from manufacturer.
- C. Warranty: Sample of special warranty.

## 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sound-absorbing wall units to include in maintenance manuals. Include fabric manufacturers' written cleaning and stain-removal recommendations.

## 1.8 QUALITY ASSURANCE

- A. Source Limitations: Obtain sound-absorbing wall units from single source from single manufacturer.
- B. Fire-Test-Response Characteristics: Provide sound-absorbing wall units meeting the following as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  1. Surface-Burning Characteristics: As determined by testing per ASTM E 84.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Meeting acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.
- C. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials, fabrication, and installation.
  1. Build mockup of typical wall area as directed by Architect.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and sound-absorbing wall unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

#### 1.10 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install sound-absorbing wall units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
- B. Lighting: Do not install sound-absorbing wall units until a permanent level of lighting is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect sound-absorbing wall units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify locations of sound-absorbing wall units and actual dimensions of openings and penetrations by field measurements before fabrication.

#### 1.11 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of sound-absorbing wall units that fail in materials or workmanship within specified warranty period.
  1. Failures include, but are not limited to the following:

- a. Acoustical performance.
  - b. Fabric sagging, distorting, or releasing from panel edge.
  - c. Warping of core.
2. Warranty Period: Two years from date of Substantial Completion.

#### 1.12 EXTRA MATERIALS

- A. Furnish extra materials from same production run that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  1. Fabric: For each fabric, color, and pattern installed, provide length equal to 10 percent of amount installed, but no fewer than 10 yards.
  2. Mounting Devices: Full-size units equal to 5 percent of amount installed, but no fewer than five devices, including unopened adhesives.

### PART 2 - PRODUCTS

#### 2.1 FABRIC WRAPPED SOUND-ABSORBING WALL UNITS

- A. Manufacturers: Provide items ACP-4, Fabric-Wrapped Acoustical Panels with KnollTextiles fabric indicated on Finish Legend on Sheet AF100 as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer:
- B. General Requirements for Sound-Absorbing Wall Units: Provide sound-absorbing wall panels that 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," including 2004 Addenda.
- C. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of facing material stretched over front face of edge-framed core and bonded or attached to edges and back of frame.
  1. Mounting: Edge mounted with splines secured to substrate.
    - a. Finish Color at Exposed Edges: As selected by Architect from manufacturer's full range.
  2. Mounting: Back mounted with manufacturer's standard adhesive or impaling clips, secured to substrate.
  3. Core: glass-fiber board.
    - a. Core-Face Layer: Manufacturer's standard tackable, impact-resistant, high-density board.
  4. Edge Construction: Manufacturer's standard chemically hardened core with no frame.

5. Edge Profile: Chamfered (beveled).
6. Corner Detail in Elevation: Square with continuous edge profile indicated.
7. Reveals between Panels: As indicated on Drawings.
8. Facing Material: Fabric indicated on Finish Legend in Drawings.
9. Acoustical Performance: Sound absorption NRC of 0.50 to 0.90 according to ASTM C 423 for Type A mounting according to ASTM E 795.
10. Nominal Core Thickness: 1 inch.
11. Panel Width: As indicated on drawings.
12. Panel Height: As indicated on Drawings.

## 2.2 SOUND-ABSORBING WALL PANELS

- A. Manufacturers: Provide items ACP-1, APC-2, and APC-3Zintra Acoustical Panels by MDC as indicated on Finish Legend on Sheet A601 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer:
- B. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of 100 percent polyester felt.
- C. Characteristics:
  1. Panel Shape: As indicated on Drawings.
  2. Mounting: Back mounted with manufacturer's recommended adhesive, secured to substrate.
  3. Thickness: 1/2 inch.
  4. Core: Manufacturer's standard 100 percent polyester felt panel.
  5. Edge Profile: Square.
  6. Acoustical Performance: Sound absorption NRC of 0.45 to 0.90.
  7. Panel Dimensions: 9 foot by 4 foot, unless indicated otherwise.
  8. Surface Finish: Matte.
  9. Colors: As indicated on Finish Legend in Drawings.
  10. Weight: 0.5 lb. per sq. ft.
  11. Fire resistance rating: Class A Flame Spread in accordance with ASTM-E84.
  12. Edge Trim: Manufacturer's standard aluminum edge trim as selected by Architect. Anodized aluminum finish.

## 2.3 TECTUM SOUND-ABSORBING WALL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  1. Tectum Inc.
- B. Sound-Absorbing Wall Panel: Manufacturer's standard panel construction consisting of exposed Tectum material and matching existing panels.
  1. Basis-of-Design Product: Standard Tectum Panel.
  2. Mounting: Back mounted with manufacturer's standard adhesive, secured to substrate.
  3. Core: Aspen wood fibers bonded with inorganic hydraulic cement

4. Edge Construction: Manufacturer's standard extruded-aluminum or zinc-coated, rolled-steel frame.
5. Edge Profile: Long edge beveled.
6. Acoustical Performance: Sound absorption NRC of not less than 0.65 according to ASTM C 423 for Type A mounting according to ASTM E 795.
7. Nominal Overall Panel Thickness: 2 inches.
8. Panel Width: As indicated on Drawings.
9. Panel Height: As indicated on Drawings.
10. Color: Custom color indicated on finish schedule in Drawings.

- C. Reuse existing Tectum panels where indicated.

## 2.4 MATERIALS

- A. General:

- B. Core Materials: Manufacturer's standard.

1. Glass-Fiber Board: ASTM C 612, Type standard with manufacturer; nominal density of 6 to 7 lb/cu. ft., unfaced, and dimensionally stable, molded rigid board; and with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively.

- C. Facing Material: Fabric from same dye lot; color and pattern as selected by Architect from manufacturer's full range.

1. Applied Treatments: Stain resistance.

- D. Mounting Devices: Concealed on back of unit, recommended by manufacturer to support weight of unit, and as follows:

1. Adhesives: As recommended by sound-absorbing wall unit manufacturer and with a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Impaling Clips: Manufacturer's standard.

## 2.5 FABRICATION

- A. General: Use manufacturer's standard construction except as otherwise indicated; with facing material applied to face, edges, and back border of dimensionally stable core; and with rigid edges to reinforce panel perimeter against warpage and damage.

1. Glass-Fiber Board Cores: Chemically harden core edges and areas of core where mounting devices are attached.

- B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

- C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
  - 1. Square Corners: Tailor corners.
- D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:
  - 1. Thickness.
  - 2. Edge straightness.
  - 3. Overall length and width.
  - 4. Squareness from corner to corner.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine fabric, fabricated units, substrates, areas, and conditions, for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing wall units.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install sound-absorbing wall units in locations indicated with vertical surfaces and edges plumb, top edges level and in alignment with other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with sound-absorbing wall unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.
- C. Align and level fabric pattern and grain among adjacent units.

#### 3.3 INSTALLATION TOLERANCES

- A. Variation from Plumb and Level: Plus or minus 1/16 inch.
- B. Variation of Panel Joints from Hairline: Not more than 1/32 inch wide.

#### 3.4 CLEANING

- A. Clip loose threads; remove pills and extraneous materials.
- B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

INDIAN HILLS MIDDLE SCHOOL  
1180 East Sanders Road, Sandy, UT 84094  
Canyons School District

100% Construction Documents

END OF SECTION 09 8433



## SECTION 09 8436 - SOUND-ABSORBING CEILING UNITS

### PART 1 - GENERAL

#### 1.1 SUMMARY

- A. Section includes shop-fabricated, acoustical panel units tested for acoustical performance, including the following:
  - 1. Sound-diffusing ceiling panels.
- B. Related Requirements:
  - 1. Section 09 5113 "Acoustical Panel Ceilings" for suspended grids for diffuser panels.

#### 1.2 DEFINITIONS

- A. NRC: Noise Reduction Coefficient.

#### 1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
  - 1. Include panel edge, core material, and mounting indicated.
- B. Shop Drawings: For unit assembly and installation.
  - 1. Include reflected ceiling plans, elevations, sections, and mounting devices and details.
  - 2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge profile and core materials.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
  - 1. Electrical outlets.
  - 2. Suspended ceiling components above ceiling units.
  - 3. Structural members to which suspension devices will be attached.

4. Items penetrating or covered by units including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Speakers.
    - d. Alarms.
    - e. Sprinklers.
    - f. Access panels.
  5. Show operation of hinged and sliding components covered by or adjacent to units.
- B. Product Certificates: For each type of unit.
- C. Sample Warranty: For manufacturer's special warranty.

#### 1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of unit to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal instructions.

#### 1.7 QUALITY ASSURANCE

- A. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials, fabrication, and installation.
1. Build mockup of typical ceiling area 96 inches wide by full width of ceiling. Include intersection of wall and ceiling, corners, and perimeters.
  2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
  3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with fabric and unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.
- B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

#### 1.9 FIELD CONDITIONS

- A. Environmental Limitations: Do not install units until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work at and above ceilings is complete, and ambient

temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

- B. Lighting: Do not install units until a lighting level of not less than 50 fc is provided on surfaces to receive the units.
- C. Air-Quality Limitations: Protect units from exposure to airborne odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.
- D. Field Measurements: Verify unit locations and actual dimensions of openings and penetrations by field measurements before fabrication, and indicate them on Shop Drawings.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace units and components that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Acoustical performance.
    - b. Warping of core.
  - 2. Warranty Period: Two years from date of Substantial Completion.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Source Limitations: Obtain ceiling units specified in this Section from single source from single manufacturer.

#### 2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: Units shall comply with "Surface-Burning Characteristics" or "Fire Growth Contribution" Subparagraph below, or both, as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
  - 1. Surface-Burning Characteristics: Comply with ASTM E84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
    - a. Flame-Spread Index: 25 or less.
    - b. Smoke-Developed Index: 450 or less.

2. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 286.

## 2.3 SOUND-DIFFUSING CEILING UNITS

- A. Sound-Diffusing Ceiling Panel: Item C4 on Finish Schedule in Drawings. Manufacturer's standard panel construction.
  1. Basis of Design Product: Provide Golterman & Sabo; PYRAMID Diffuser – WCD.
    - a. Equivalent Products: Substitutions of equivalent products by one of the following manufacturers will be considered prior to bid if the product complies with specified product requirements and is substantially similar in appearance to the Basis of Design product, as judged solely by the Architect:
      - 1) Armstrong World Industries, Inc.
      - 2) Decoustics Limited; a Saint Gobain company.
      - 3) Wenger Corporation.
  2. Panel Shape: PYRAMID.
  3. Mounting: Back mounted with suspension system specified in Section 09 5113 "Acoustical Panel Ceilings", secured to substrate.
  4. Core: Manufacturer's standard, prepared for required acoustical performance.
  5. Panel Width: 24 by 24 inches.

## 2.4 MATERIALS

- A. Core Materials:
  1. Cementitious-Wood Fiber Board: Aspen wood fibers bonded with inorganic hydraulic cement and with density of not less than 20 lb/cu. ft.
  2. Fire-Retardant Formed Plastic: Manufacturer's standard formed plastic with flame-spread index of 25 or less and smoke-developed index of 25 or less according to ASTM E84 or UL 723.
- B. Mounting Devices: Concealed on back or top edge of unit, recommended by manufacturer to support weight of unit.

## 2.5 FABRICATION

- A. Standard Construction: Use manufacturer's standard construction unless otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.
- B. Measure each area and establish layout of panels and joints of uniform size with balanced borders at opposite edges within a given area.

C. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

1. Thickness.
2. Edge straightness.
3. Overall length and width.
4. Squareness from corner to corner.
5. Chords, radii, and diameters.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting unit performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install units in locations indicated. Unless otherwise indicated, install units with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.
- B. Comply with manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

3.3 INSTALLATION TOLERANCES

- A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch in 48 inches, noncumulative.
- B. Variation from Level or Slope: Plus or minus 1/16 inch.
- C. Variation of Joint Width: Not more than 1/16-inch-wide from hairline in 48 inches, noncumulative.

3.4 CLEANING

- A. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION 09 8436

## SECTION 09 9123 - INTERIOR PAINTING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Steel.
  - 2. Gypsum board.
  - 3. Tectum panels.
- B. Related Requirements:
  - 1. Section 05 1200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
  - 2. Section 09 9600 "High-Performance Coatings" for high-performance and special-use coatings.
  - 3. Section 09 9113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.

#### 1.3 DEFINITIONS

- A. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for 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.

C. Product List: 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. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
3. VOC content.

## 1.5 QUALITY ASSURANCE

- A. Painter Qualifications: Use painters that can provide evidence of having a minimum of five years experience with projects similar in scope to this project.
- B. 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.

## 1.6 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.

## 1.7 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. PPG Architectural Finishes, Inc.
  - 3. Sherwin-Williams Company (The).
- B. Products: Subject to compliance with requirements, provide one of the products listed in other Part 2 articles for the paint category indicated.

### 2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
  - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
  - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: For field applications that are inside the weatherproofing system, paints and coatings shall comply with VOC content limits of authorities having jurisdiction and the following VOC content limits:
  - 1. Flat Paints and Coatings: 50 g/L.
  - 2. Nonflat Paints and Coatings: 150 g/L.
  - 3. Primers, Sealers, and Undercoaters: 200 g/L.
  - 4. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
  - 5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
- D. Colors: As indicated on Finish Legend in Drawings, or if not indicated, as selected by Architect from manufacturer's full range.



## 2.3 PRIMERS/SEALERS

### A. Primer Sealer, Latex, Interior: MPI #50.

1. Products: Provide primer for items P-1 & P-2 by Sherwin-Williams as indicated below and on Finish Legend on Sheet A601 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:
  - a. Benjamin Moore: Fresh Start; High Hiding All Purpose Primer - 046/K046.
  - b. PPG Architectural: PPG Paints; Speedhide Zero Interior Zero VOC Latex Sealer - 6-4900XI.
  - c. Sherwin-Williams: ProGreen 200; Low VOC Interior Latex Primer - B28W00600

## 2.4 WATER-BASED PAINTS

### A. Latex, Interior, High Performance Architectural, (Gloss Level 2): MPI #138.

1. Products: Provide topcoats P-1 & by Sherwin-Williams as indicated below and on Finish Legend on Sheet A601 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:
  - a. Benjamin Moore: Aura; Waterborne Eggshell Interior Paint - 524/K524.
  - b. PPG Architectural: Glidden Professional (US): Diamond 450 No VOC Matte Premium Int. Paint - 7100N.
  - c. Sherwin-Williams: Duration Home; Interior Latex Satin - A97W00151/A97WQ8151.

### B. Latex, Interior, High Performance Architectural, (Gloss Level 3): MPI #139.

1. Products: Provide topcoats for items P-1 & P-2 by Sherwin-Williams as indicated below and on Finish Legend on Sheet A601 or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by one of the following manufacturers:
  - a. Benjamin Moore: Ultra Spec 500: Interior Eggshell Finish - N38/K538.
  - b. PPG: Pittsburgh Paints; Manor Hall Int.100% Acrylic Latex- Eggshell - 83-310.
  - c. Sherwin-Williams: Pro Industrial; Pre-Catalyzed Waterbased Epoxy Eg-Shel - K45W00151.

### C. Non-Bridging Dry Fall Paint (For Tectum Panels):

1. Sherwin-Williams: Waterborne Acrylic Dry Fall – B42W1.

## 2.5 SOURCE QUALITY CONTROL

### A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

### 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. Gypsum Board: 12 percent.
- C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
- D. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- E. Proceed with coating application only after unsatisfactory conditions have been corrected.
  1. Application of coating indicates acceptance of surfaces and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
  1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
  - 1. Apply stains per manufacturer's written instructions.
- E. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
  - 1. SSPC-SP 3, "Power Tool Cleaning."
- F. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
  - 1. Use applicators and techniques suited for paint and substrate indicated.
  - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
  - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
  - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
  - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. 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.
- D. 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.
  - b. Uninsulated metal piping.
  - c. Uninsulated plastic piping.
  - d. Pipe hangers and supports.
  - e. Metal conduit.
  - f. Plastic conduit.
  - g. Tanks that do not have factory-applied final finishes.
  - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
2. Paint the following work where exposed in occupied spaces:
  - a. Equipment, including panelboards.
  - b. Uninsulated metal piping.
  - c. Uninsulated plastic piping.
  - d. Pipe hangers and supports.
  - e. Metal conduit.
  - f. Plastic conduit.
  - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
  - h. Other items as directed by Architect.
3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

### 3.4 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.

### 3.6 INTERIOR PAINTING SCHEDULE

#### A. Steel Substrates:

##### 1. High-Performance Architectural Latex System:

- a. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- c. Topcoat: Latex, interior, high performance architectural, semi-gloss (Gloss Level 5), MPI #141.

#### B. Gypsum Board Wall Substrates:

##### 1. High-Performance Architectural Latex System:

- a. Prime Coat: Primer sealer, latex, interior, MPI #50.
- b. Intermediate Coat: Latex, interior, high performance architectural, matching topcoat.
- c. Topcoat: Latex, interior, high performance architectural, (Gloss Level 3), MPI #139.

#### C. Tectum Panel Substrates:

##### 1. Acrylic Dry Fall System: (spray-apply only).

- a. Topcoat: Manufacturer's recommended non-bridging dry fall paint.

END OF SECTION 09 9123

## SECTION 10 1100 - VISUAL DISPLAY SURFACES

### 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. Markerboards.
  - 2. Tackboards.

#### 1.3 DEFINITIONS

- A. Tackboard: Framed or unframed, tackable, visual display board assembly.
- B. Visual Display Board Assembly: Visual display surface that is factory fabricated into composite panel form, either with or without a perimeter frame; includes chalkboards, markerboards, and tackboards.
- C. Visual Display Surface: Surfaces that are used to convey information visually, including surfaces of chalkboards, markerboards, tackboards, and surfacing materials that are not fabricated into composite panel form but are applied directly to walls.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
- B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Show locations of panel joints.
  - 2. Include sections of typical trim members.
- C. Samples for Verification: For each type of visual display surface indicated.
  - 1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
  - 2. Trim: 6-inch- long sections of each trim profile.

- 3. Display Rail: 6-inch- long sections.
- 4. Accessories: Full-size Sample of each type of accessory.
- D. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.
- E. Qualification Data: For qualified Installer.
- F. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for surface-burning characteristics of fabrics.
- G. Maintenance Data: For visual display surfaces to include in maintenance manuals.
- H. Warranties: Sample of special warranties.

#### 1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of motor-operated, sliding visual display units required for this Project.
- B. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
- C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate appearance and aesthetic effects and set quality standards for installation.
  - 1. Build mockup of typical wall area as shown on Drawings. Include accessories.
  - 2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- D. Preinstallation Conference: Conduct conference at Project site.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefabricate components at the factory, disassemble for delivery, and make final joints at the site.
- B. Store visual display surfaces vertically with packing materials between each unit.

#### 1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install visual display surfaces until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

- B. Field Measurements: Verify actual dimensions of construction contiguous with visual display surfaces by field measurements before fabrication.
  - 1. Allow for trimming and fitting where taking field measurements before fabrication might delay the Work.

## 1.8 WARRANTY

- A. Special Warranty for Porcelain-Enamel Face Sheets: Manufacturer's standard form in which manufacturer agrees to repair or replace porcelain-enamel face sheets that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Surfaces lose original writing and erasing qualities.
    - b. Surfaces exhibit crazing, cracking, or flaking.
  - 2. Warranty Period: 50 years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 MATERIALS, GENERAL

- A. Porcelain-Enamel Face Sheet: Manufacturer's standard steel sheet with porcelain-enamel coating fused to steel; uncoated thickness indicated.
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Claridge Products and Equipment, Inc.
    - b. PolyVision Corporation; a Steelcase company.
  - 2. Matte Finish: Low reflective; chalk wipes clean with dry cloth or standard eraser.
- B. Plastic-Impregnated Cork Sheet: Seamless, homogeneous, self-sealing sheet consisting of granulated cork, linseed oil, resin binders, and dry pigments that are mixed and calendared onto fabric backing; with washable vinyl finish and integral color throughout.
- C. Fiberboard: ASTM C 208.
- D. Extruded Aluminum: ASTM B 221, Alloy 6063.

### 2.2 MARKERBOARD ASSEMBLIES

- A. Porcelain-Enamel Markerboards: Balanced, high-pressure, factory-laminated markerboard assembly of three-ply construction consisting of backing sheet, core material, and 0.021-inch-thick, porcelain-enamel face sheet with low-gloss finish.



1. Basis of Design: Subject to compliance with requirements, provide TS-200 Tack Strip as provided by Inwest Manufacturing, or equivalent product, approved by Architect prior to bid, by one of the following:
  - a. AARCO Products, Inc.
  - b. ADP Lemco, Inc.
  - c. Best-Rite Manufacturing.
  - d. Claridge Products and Equipment, Inc.
  - e. Egan Visual Inc.
  - f. Ghent Manufacturing, Inc.
  - g. Marsh Industries, Inc.; Visual Products Group.
  - h. Platinum Visual Systems; a division of ABC School Equipment, Inc.
2. Fiberboard Core: 3/8 inch thick; with 0.015-inch- thick, aluminum sheet backing.
3. Laminating Adhesive: Manufacturer's standard, moisture-resistant thermoplastic type.

## 2.3 TACKBOARD ASSEMBLIES

- A. Manufacturers: Provide item TB-1 Walltalkers tac-wall by Koroseal as indicated on Finish Legend on Sheet AF100 or, subject to compliance with requirements, equivalent product approved by Architect prior to bid by another manufacturer.
  1. Tackboard: 1/4-inch- thick, resilient, homogeneous, tackable linoleum surface consisting of linseed oil, granulated cork, rosin binders, and dry pigments calendared onto natural burlap backing.
    - a. Color: as indicated on Finish legend.

## 2.4 MARKERBOARD AND TACKBOARD ACCESSORIES

- A. Aluminum Frames and Trim: Fabricated from not less than 0.062-inch- thick, extruded aluminum; of size and shape indicated on Drawings.
  1. Factory-Applied Trim: Manufacturer's standard.
- B. Chalktray: Manufacturer's standard, continuous.
  1. Box Type: Extruded aluminum with slanted front, grooved tray, and cast-aluminum end closures.
- C. Map Rail: Provide the following accessories:
  1. Display Rail: Continuous and integral with map rail; fabricated from cork approximately 1 to 2 inches wide.
  2. End Stops: Located at each end of map rail.
  3. Map Hooks: Two map hooks for every 48 inches of map rail or fraction thereof.
  4. Map Hooks and Clips: Two map hooks with flexible metal clips for every 48 inches of map rail or fraction thereof.

5. Flag Holder: One for each room.
6. Paper Holder: Extruded aluminum; designed to hold paper by clamping action.

## 2.5 FABRICATION

- A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.
- B. Visual Display Boards: Factory assemble visual display boards unless otherwise indicated.
  1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.
- C. Factory-Assembled Visual Display Units: Coordinate factory-assembled units with trim and accessories indicated. Join parts with a neat, precision fit.
  1. Make joints only where total length exceeds maximum manufactured length. Fabricate with minimum number of joints, balanced around center of board, as acceptable to Architect.
  2. Provide manufacturer's standard vertical-joint spline system between abutting sections of markerboards.
  3. Provide manufacturer's standard mullion trim at joints between of combination units.
  4. Where size of visual display boards or other conditions require support in addition to normal trim, provide structural supports or modify trim as indicated or as selected by Architect from manufacturer's standard structural support accessories to suit conditions indicated.
- D. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
  1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

## 2.6 GENERAL FINISH REQUIREMENTS

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

## 2.7 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

## 2.8 VISUAL DISPLAY SURFACE SCHEDULE

- A. Visual Display Board: Factory assembled.

- 1. Markerboard: Porcelain-enamel markerboard assembly.
  - a. Color: White.
- 2. Corners: Square.
- 3. Width: As indicated on Drawings.
- 4. Height: As indicated on Drawings.
- 5. Mounting: Wall.
- 6. Mounting Height: As indicated on Drawings.
- 7. Factory-Applied Aluminum Trim: Manufacturer's standard with clear anodic finish.
- 8. Accessories:
  - a. Chalktray: Box type.
  - b. Map rail with display rail, end stops, map hooks and clips, and flag holder.

- B. Tackboard: Factory assembled.

- 1. Tack Surface: Plastic-Impregnated Cork tackboard assembly.
  - a. Color: As indicated on Finish Legend.
- 2. Corners: Square.
- 3. Width: As indicated on Drawings.
- 4. Height: As indicated on Drawings.
- 5. Mounting: Wall.
- 6. Mounting Height: As indicated on Drawings.
- 7. Edges: Concealed by trim.
  - a. Factory-Applied Aluminum Trim: Manufacturer's standard style, with clear anodic finish.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.
- B. Examine walls and partitions for proper preparation and backing for visual display surfaces.

- C. Examine walls and partitions for suitable framing depth where sliding visual display units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.
- C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
  - 1. Prime wall surfaces indicated to receive direct-applied, visual display tack wall panels and as recommended in writing by primer/sealer manufacturer and wall covering manufacturer.

### 3.3 INSTALLATION, GENERAL

- A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights indicated below. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

### 3.4 INSTALLATION OF FACTORY-FABRICATED VISUAL DISPLAY BOARDS AND ASSEMBLIES

- A. Visual Display Boards: Attach visual display boards to wall surfaces with egg-size adhesive gobs at 16 inches o.c., horizontally and vertically.
- B. Visual Display Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

### 3.5 CLEANING AND PROTECTION

- A. Clean visual display surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.
- B. Touch up factory-applied finishes to restore damaged or soiled areas.
- C. Cover and protect visual display surfaces after installation and cleaning.

INDIAN HILLS MIDDLE SCHOOL  
1180 East Sanders Road, Sandy, UT 84094  
Canyons School District

100% Construction Documents

END OF SECTION 10 1100

## SECTION 10 1423 - SIGNAGE

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Room-identification signs.
- B. Related Requirements:
  - 1. Section 01 5000 "Temporary Facilities and Controls" for temporary Project identification signs and for temporary information and directional signs.

#### 1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

#### 1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.
- C. Coordinate with Architect and Owner for installation vinyl graphics designed by Owner.

#### 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
  - 1. Include fabrication and installation details and attachments to other work.
  - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
  - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

- C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
  - 1. Include representative Samples of available typestyles and graphic symbols.
- D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer's standard size unless otherwise indicated and as follows:
  - 1. Panel Signs: Full-size Sample.
  - 2. Room-Identification Signs: Full-size Sample.
- E. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

#### 1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

#### 1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

#### 1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer of products.

#### 1.9 FIELD CONDITIONS

- A. Field Measurements: Verify locations of anchorage devices embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

#### 1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
  - 1. Failures include, but are not limited to, the following:
    - a. Deterioration of finishes beyond normal weathering.
    - b. Deterioration of embedded graphic image.
    - c. Separation or delamination of sheet materials and components.

2. Warranty Period: Five years from date of Substantial Completion.

## PART 2 - PRODUCTS

### 2.1 PANEL SIGNS, GENERAL

- A. Regional Materials: Panel signs shall be manufactured within 500 miles of Project site.

### 2.2 SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
  1. Basis-of-Design Product: Indicated on Drawings.
  2. Sign-Panel Perimeter: Finish edges smooth.
    - a. Edge Condition: As indicated.
    - b. Corner Condition in Elevation: As indicated.
  3. Mounting: Manufacturer's standard method for substrates indicated with.
  4. Text and Typeface: Accessible raised characters and Braille typeface as selected by Architect from manufacturer's full range and variable content as scheduled.

### 2.3 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.
  1. For Acrylic Panel Graphic, use 3M VHB Architectural Panel Tape.

### 2.4 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
  1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
  1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
  2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.



3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
  4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.

## 2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. Directional Finishes: Run grain with long dimension of each piece and perpendicular to long dimension of finished trim or border surface unless otherwise indicated.
- D. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.

## 2.6 ALUMINUM FINISHES

- A. Clear Anodic Finish: AAMA 611, Class II, 0.010 mm or thicker.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.
- C. Verify that anchor inserts are correctly sized and located to accommodate signs.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
  - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
  - 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
  - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
  - 4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
- B. Room-Identification Signs and Other Accessible Signage: Install in locations on walls as indicated and according to accessibility standard.
- C. Mounting Methods:
  - 1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
  - 2. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
  - 3. Hook-and-Loop Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply sign component of two-part tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage; push to engage tape adhesive. Keep tape strips 0.250 inch away from edges to prevent visibility at sign edges when sign is initially installed or reinstalled. Apply substrate component of tape to substrate in locations aligning with tape on back of sign; push and rub well to fully engage tape adhesive to substrate.
- D. Signs Mounted on Glass: Provide opaque sheet matching sign material and finish onto opposite side of glass to conceal back of sign.

### 3.3 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

3.4 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain LED monument signage.

END OF SECTION 10 1423

## SECTION 12 3623 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

### 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 plastic-laminate countertops.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product, including high-pressure decorative laminate and adhesive for bonding plastic laminate.
- B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
  - 1. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in plastic-laminate countertops.
  - 2. Apply AWI Quality Certification Program label to Shop Drawings.
- C. Samples for Initial Selection:
  - 1. Plastic laminates.
- D. Samples for Verification:
  - 1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish and specified edge material applied to one edge.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer.
- B. Product Certificates: For each type of product.
- C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

## 1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Shop is a certified participant in AWI's Quality Certification Program.
- B. Installer Qualifications: Certified participant in AWI's Quality Certification Program.

## 1.6 DELIVERY, STORAGE, AND HANDLING

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

## 1.7 FIELD CONDITIONS

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

## PART 2 - PRODUCTS

### 2.1 PLASTIC-LAMINATE COUNTERTOPS

- A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.
  - 1. Provide certificates from AWI certification program indicating that countertops, including installation, comply with requirements of grades specified.
  - 2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. Grade: Custom.
- C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.

1. Manufacturers: Provide items PL-1 & PL-2 as indicated on Finish Legend (TO MATCH EXISTING) on Sheet A601 by the following manufacturers or, subject to compliance with requirements, equivalent products approved by Architect prior to bid by another manufacturer:
    - a. Formica Corporation.
    - b. Nevamar
  - D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
    1. As indicated on Finish Schedule.
  - E. Edge Treatment: 2-mm PVC edging.
    1. **Front edge same as laminate cladding on horizontal surfaces.**
    2. **Configuration:**
      - a. **Front: Full bullnose.**
      - b. **Backsplash: Integral with countertop.**
  - F. Core Material: Premium grade 45 lbs. particleboard
  - G. Core Material at Sinks: Premium grade 45 lbs. particleboard made with exterior glue
  - H. Core Thickness: 3/4 inch.
    1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.
  - I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.
  - J. Paper Backing: Provide paper backing on underside of countertop substrate.
- 2.2 WOOD MATERIALS
- A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.
- 2.3 ACCESSORIES
- A. Grommets for Cable Passage through Countertops: 1-1/4-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.
    1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc.

## 2.4 MISCELLANEOUS MATERIALS

- A. Adhesives: Do not use adhesives that contain urea formaldehyde.

## 2.5 FABRICATION

- A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets.
- B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.
  - 1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
- C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.
  - 1. Seal edges of openings in countertops with a coat of varnish.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.
- B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

### 3.2 INSTALLATION

- A. Grade: Install countertops to comply with same grade as item to be installed.
- B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
  - 1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
  - 2. Seal edges of cutouts by saturating with varnish.
- C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.
- D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.
- E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
- F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
  1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
  2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
  3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

### 3.3 ADJUSTING AND CLEANING

- A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.
- B. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 12 3623



## SECTION 21 1000 - WATER-BASED FIRE-SUPPRESSION 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 the following fire-suppression piping inside the building:
1. Wet-pipe sprinkler systems.
  2. Description: Remodel of small area, move sprinklers as needed, keep existing where possible.
- B. Related Sections include the following:
1. Division 10 Section "Fire Extinguisher Cabinets" and "Fire Extinguishers" for cabinets and fire extinguishers.
  2. Division 22 Section "Facility Water Distribution Piping" for piping outside the building.
  3. Division 28 Section "Fire Detection and Alarm" for alarm devices not specified in this Section.
- C. All black steel sprinkler pipe shall have a wall thickness less than or equal to schedule 40 and greater than schedule 10.
1. Exception: Pipe with a nominal pipe size of 6 inches and greater may be schedule 10.

D. Summary Table:

Item	Summary
Underground service entrance piping	Existing to remain
Interior pipe type	Mains: Schedule 40 Branchlines: Threadable thinwall or schedule 40
Sprinkler Finish	Match Existing
Extended Coverage	Not Allowed
Center of Tile	Required, Center thirds are acceptable for rectangular tiles
Flexible Sprinkler Drops	Not allowed, unless hydraulic calculations included
FM Global	No
Calculations	Required, use reduced flow data
Alarm Device	Horn/Strobe
FDC	Existing to remain
Coordination	All sprinkler piping exposed to view shall be coordinated with the architect prior to final design acceptance.

### 1.3 DEFINITIONS

- A. CPVC: Chlorinated polyvinyl chloride plastic.
- B. CR: Chlorosulfonated polyethylene synthetic rubber.
- C. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.
- D. PE: Polyethylene plastic.
- E. Underground Service-Entrance Piping: Underground service piping below the building.

### 1.4 SYSTEM DESCRIPTIONS

- A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

### 1.5 PERFORMANCE REQUIREMENTS

- A. Standard Piping System Component Working Pressure: Listed for at least 175 psig.
- B. High-Pressure Piping System Component Working Pressure: Listed for 250 psig minimum 300 psig.
- C. Design sprinkler piping according to the following and obtain approval from engineer, prior to submitting to other authorities having jurisdiction:
  - 1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
  - 2. Sprinkler Occupancy Hazard Classifications:
    - a. Building Service Areas: Ordinary Hazard, Group 1.
    - b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
    - c. General Storage Areas: Ordinary Hazard, Group 1.
    - d. Laundries: Ordinary Hazard, Group 1.
    - e. Libraries, Except Stack Areas: Light Hazard.
    - f. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
    - g. Office and Public Areas: Light Hazard.
    - h. Restaurant Service Areas: Ordinary Hazard, Group 1.
  - 3. Minimum Density for Automatic-Sprinkler Piping Design:
    - a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
    - b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
    - c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
    - d. Extra-Hazard, Group 1 Occupancy: 0.30 gpm over 2500-sq. ft. area.
    - e. Extra-Hazard, Group 2 Occupancy: 0.40 gpm over 2500-sq. ft. area.
    - f. Special Occupancy Hazard: As determined by authorities having jurisdiction.

4. Maximum Protection Area per Sprinkler: Per UL listing.
  5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13, unless otherwise indicated:
    - a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
    - b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.
    - c. Extra-Hazard Occupancies: 500 gpm for 90 to 120 minutes.
  6. Sprinklers are to be installed throughout the premises, as required by NFPA 13.
- D. Seismic Performance: Fire-suppression piping shall be capable of withstanding the effects of earthquake motions determined according to NFPA 13.

## 1.6 SUBMITTALS

- A. Product Data: For the following:
1. Piping materials, and sprinkler specialty fittings.
  2. Pipe hangers and supports, including seismic restraints.
  3. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish, and other pertinent data.
  4. Alarm devices, including electrical data.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Seismic Calculations.
- D. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations, if applicable. Drawings are to be approved by Engineer prior to submission to State Fire Marshal.
1. Installation and Fabrication drawings indicating the location of rigid couplings, seismic separation assemblies, planned clearance cut-outs between piping and solid structural members for seismic movement, and any additional anchoring points required for ceiling systems where sprinklers are fixed or supported in accordance with NFPA.
- E. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."
- F. Welding certificates.
- G. Field quality-control test reports.
- H. Operation and Maintenance Data: For standpipe and sprinkler specialties to include in emergency, operation, and maintenance manuals.

## 1.7 QUALITY ASSURANCE

- A. Installer Qualifications:

1. An experienced installer who has designed and installed fire-suppression piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction. The Engineer requires evidence to support the ability of the contractor to perform work in the scope and volume as specified. A contractor, who cannot show such experience, may be found not suitable to perform the work. The following are the approved contractors for this project:
  - a. PRE-APPROVED CONTRACTORS LIST
    - 1) A&D Fire
    - 2) Alta Fire
    - 3) Blazemaster Fire Protection
    - 4) Broken Arrow Fire Protection
    - 5) Certified Fire
    - 6) Delta Fire
    - 7) FireTrol
    - 8) FireFly Fire Protection
    - 9) Interwest Fire Protection
    - 10) Kimco Fire
    - 11) Quality Fire Protection
    - 12) Pye Barker Co.
    - 13) State Fire DC Specialties
    - 14) Summit Fire & Security
    - 15) The Safety Team (TST)
    - 16) Western Automatic Sprinkler Co.
    - 17) Or prior approved equal
  - b. A contractor not listed in the "PRE-APPROVED CONTRACTORS LIST" must receive prior approval from the engineer to bid this project.
- B. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
  1. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or NICET Level III technician.
- C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:
  1. NFPA 13, "Installation of Sprinkler Systems."
- E. International Conference of Building Code Officials codes and standards complying with the following:
  1. IBC-2021, "International Building Code."
  2. IFC-2021, "International Fire Code."
- F. Utah Amendments
  1. Title 15A

1.8 COORDINATION

- A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.9 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. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

1.10 General Engineering Quality

- A. Unless noted otherwise the following applies:
  - 1. The maximum water velocity shall not exceed 32-fps.
  - 2. Submit the calculations using the reduced flow data.
  - 3. When calculating flexible drops, the contractor shall use the maximum number of bends for the associated length. The value is to be taken from the UL tests (unless the material is only FM approved).
  - 4. In the event of multiple (3) submittal rejections (including revise and resubmit) a meeting shall be held at the engineer's office at the engineer time of choosing and the designer, fire sprinkler contractor, and general contractor shall be physically in attendance to discuss the required modifications to the design.

1.11 Contract Completion

- A. Incomplete and Unacceptable work:
  - 1. If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

## 2.2 DUCTILE-IRON PIPE AND FITTINGS

- A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, with mechanical-joint bell end and plain end.
  - 1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, Class 53, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.
- B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, with push-on-joint bell end and plain end.
  - 1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.
  - 2. Gaskets: AWWA C111, rubber.

## 2.3 STEEL PIPE AND FITTINGS

- A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed threaded ends.
  - 1. Cast-Iron Threaded Flanges: ASME B16.1.
  - 2. Malleable-Iron Threaded Fittings: ASME B16.3.
  - 3. Gray-Iron Threaded Fittings: ASME B16.4.
  - 4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe hot-dip galvanized where indicated. Include ends matching joining method.
  - 5. Steel Threaded Couplings: ASTM A 865 hot-dip galvanized-steel pipe where indicated.
- B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe not allowed.
  - 1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
- C. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795 hot-dip galvanized-steel pipe not allowed.
  - 1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  - 2. Steel Flanges and Flanged Fittings: ASME B16.5.
- D. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized where indicated and with factory- or field-formed, roll-grooved ends.
  - 1. Grooved-Joint Piping Systems:
    - a. Manufacturers:
      - 1) Anvil International, Inc.
      - 2) Bull Moose Tube Co.

- 3) Grinnell (Tyco)
  - 4) Victaulic Co. of America.
  - 5) Wheatland Tube
- b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
- c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.
- E. Threaded-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed threaded ends.
1. Cast-Iron Threaded Flanges: ASME B16.1.
  2. Malleable-Iron Threaded Fittings: ASME B16.3.
  3. Gray-Iron Threaded Fittings: ASME B16.4.
  4. Steel Threaded Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M or ASTM A 106, Schedule 40, seamless steel pipe.
  5. Steel Threaded Couplings: ASTM A 865.
- F. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10 not allowed.
1. Locking-Lug Fittings: UL 213, ductile-iron body with retainer lugs that require one-quarter turn to secure pipe in fitting not allowed.
- G. Plain-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10 not allowed.
1. Steel Welding Fittings: ASTM A 234/A 234M, and ASME B16.9 or ASME B16.11.
  2. Steel Flanges and Flanged Fittings: ASME B16.5.
- H. Grooved-End, Threadable, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 40 and greater than Schedule 10, and with factory- or field-formed, roll-grooved ends.
1. Grooved-Joint Piping Systems:
    - a. Manufacturers:
      - 1) Anvil International, Inc.
      - 2) Bull Moose Tube Co.
      - 3) Grinnell (Tyco)
      - 4) Victaulic Co. of America.
      - 5) Wheatland Tube
    - b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
    - c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, prelubricated rubber gasket listed for use with housing, and steel bolts and nuts.

- I. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 is not allowed.
- J. Plain-End, Nonstandard OD, Thinwall Steel Pipe: ASTM A 135 or ASTM A 795, with wall thickness less than Schedule 10 is not allowed.
- K. Plain-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5 is not allowed.
- L. Grooved-End, Hybrid Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with wall thickness less than Schedule 10 and greater than Schedule 5; with factory- or field-formed, roll-grooved ends are not allowed.
- M. Schedule 5 Steel Pipe: ASTM A 135 or ASTM A 795, lightwall, with plain ends is not allowed.

## 2.4 CPVC TUBE AND FITTINGS

- A. CPVC fire sprinkler pipe and fittings are not allowed.

## 2.5 FLEXIBLE SPRINKLER DROPS

- A. Flexible connectors shall be exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
  - 1. NPS 1: Threaded.
- B. Manufacturers:
  - 1. Flex-Head
  - 2. Victaulic
- C. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- D. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

## 2.6 FLEXIBLE PIPE CONNECTORS (SEISMIC)

- A. Flexible connectors shall be exterior wire braid and have materials suitable for system fluid. Include 175-psig minimum working-pressure rating and ends according to the following:
  - 1. NPS 2 and Smaller: Threaded.
  - 2. NPS 2-1/2 and Larger: Flanged.
  - 3. Option for NPS 2-1/2 and Larger: Grooved for use with grooved-end-pipe couplings.
- B. Manufacturers:



1. Flexicraft Industries.
2. Flex-Pression, Ltd.
3. Metraflex, Inc.

- C. Bronze-Hose, Flexible Connectors: Corrugated, bronze, inner tubing covered with bronze wire braid. Include copper-tube ends or bronze flanged ends, braze welded to hose.
- D. Stainless-Steel-Hose/Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include steel nipples or flanges, welded to hose.
- E. Stainless-Steel-Hose/Stainless-Steel Pipe, Flexible Connectors: Corrugated, stainless-steel, inner tubing covered with stainless-steel wire braid. Include stainless-steel nipples or flanges, welded to hose.

## 2.7 CORROSION-PROTECTIVE ENCASEMENT FOR PIPING

- A. Encasement for Underground Metal Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

## 2.8 SPRINKLER SPECIALTY FITTINGS

- A. Sprinkler specialty fittings shall be 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 250-psig minimum working-pressure rating if fittings are components of high-pressure piping systems.
- B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body, with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

### 1. Manufactures:

- a. Central Sprinkler Corp.
  - b. Fire-End and Croker Corp.
  - c. Viking Corp.
  - d. Victaulic Co. of America.
- C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.
- D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.
- E. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

## 2.9 LISTED FIRE-PROTECTION VALVES

- A. Valves shall be 175-psig minimum pressure rating. Valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.
- B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.
  2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.
  3. Manufacturers:
    - a. Grinnell Fire Protection.
    - b. McWane, Inc.; Kennedy Valve Div.
    - c. NIBCO.
    - d. Stockham.
- C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
  2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
  3. NPS 3: Ductile-iron body with grooved ends.
  4. Manufacturers:
    - a. NIBCO.
    - b. Victaulic Co. of America.
- D. Butterfly Valves: UL 1091.
1. NPS 2 and Smaller: Bronze body with threaded ends.
    - a. Manufacturers:
      - 1) Global Safety Products, Inc.
      - 2) Milwaukee Valve Company.
  2. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
    - a. Manufacturers:
      - 1) Central Sprinkler Corp.
      - 2) McWane, Inc.; Kennedy Valve Div.
      - 3) Mueller Company.
      - 4) NIBCO.
      - 5) Victaulic Co. of America.
- E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
1. Manufacturers:
    - a. American Cast Iron Pipe Co.; Waterous Co.
    - b. Central Sprinkler Corp.
    - c. Clow Valve Co.
    - d. Crane Co.; Crane Valve Group; Crane Valves.
    - e. Crane Co.; Crane Valve Group; Jenkins Valves.
    - f. Fivalco Inc. dba Aleum USA
    - g. Globe Fire Sprinkler Corporation.

- h. Grinnell Fire Protection.
- i. Hammond Valve.
- j. McWane, Inc.; Kennedy Valve Div.
- k. Mueller Company.
- l. NIBCO.
- m. Potter-Roemer; Fire Protection Div.
- n. Reliable Automatic Sprinkler Co., Inc.
- o. Star Sprinkler Inc.
- p. Stockham.
- q. United Brass Works, Inc.
- r. Victaulic Co. of America.
- s. Watts Industries, Inc.; Water Products Div.

F. Gate Valves: UL 262, OS&Y type.

1. NPS 2 and Smaller: Bronze body with threaded ends.

a. Manufacturers:

- 1) Crane Co.; Crane Valve Group; Crane Valves.
- 2) Fivalco Inc. dba Aleum USA.
- 3) Hammond Valve.
- 4) NIBCO.
- 5) United Brass Works, Inc.

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

a. Manufacturers:

- 1) Clow Valve Co.
- 2) Crane Co.; Crane Valve Group; Crane Valves.
- 3) Crane Co.; Crane Valve Group; Jenkins Valves.
- 4) Fivalco Inc. dba Aleum USA
- 5) Hammond Valve.
- 6) Milwaukee Valve Company.
- 7) Mueller Company.
- 8) NIBCO.
- 9) United Brass Works, Inc.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

- 1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and Visual.
- 2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Manufacturers:

- 1) Fivalco Inc. dba Aleum USA
- 2) Milwaukee Valve Company.
- 3) NIBCO.
- 4) Victaulic Co. of America.

- 3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

- 1) Central Sprinkler Corp.
- 2) Fivalco Inc. dba Aleum USA
- 3) Grinnell Fire Protection.
- 4) McWane, Inc.; Kennedy Valve Div.
- 5) Milwaukee Valve Company.
- 6) NIBCO.
- 7) Victaulic Co. of America.

H. Supervised Normally Closed Valve

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch and visual to send signal on partial close.

a. Manufactures:

- 1) Fivalco Inc. dba Aleum USA
- 2) NIBCO.
- 3) Victaulic Co. of America.

2.10 UNLISTED GENERAL-DUTY VALVES

- A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.
- B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.
- C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.
- D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.11 SPECIALTY VALVES

- A. Sprinkler System Control Valves: Cast- or ductile-iron body with flanged or grooved ends, and 175-psig minimum pressure rating. Control valves shall have 250-psig minimum pressure rating if valves are components of high-pressure piping system.

1. Manufacturers:

- a. Globe Fire Sprinkler Corporation.
- b. Reliable Automatic Sprinkler Co., Inc.
- c. Victaulic Co. of America.
- d. Viking Corp.

- B. Automatic Drain Valves: UL 1726, NPS 3/4, ball-check device with threaded ends.

1. Manufacturers:

- a. Grinnell Fire Protection.

## 2.12 SPRINKLERS

- A. Sprinklers shall be UL listed with 175-psig minimum pressure rating. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- B. Sprinklers shall have 250-psig minimum 300-psig pressure rating if sprinklers are components of high-pressure piping system.
- C. Manufacturers:
  - 1. Globe Fire Sprinkler Corporation.
  - 2. Reliable Automatic Sprinkler Co., Inc.
  - 3. Victaulic Co. of America.
  - 4. Viking Corp.
  - 5. Tyco Fire
- D. Automatic Sprinklers: With heat-responsive element complying with the following:
  - 1. UL 199, for nonresidential applications.
  - 2. UL 1626, for residential applications.
- E. Sprinkler Types and Categories: Nominal 1/2-inch orifice for "Ordinary" temperature classification rating, unless otherwise indicated or required by application.
  - 1. Open Sprinklers: UL 199, without heat-responsive element.
    - a. Orifice: 1/2 inch, with discharge coefficient K between 5.3 and 5.8.
    - b. Orifice: 17/32 inch, with discharge coefficient K between 7.4 and 8.2.
- F. Sprinkler types, features, and options as follows:
  - 1. Concealed ceiling sprinklers, including cover plate.
  - 2. Extended-coverage sprinklers, not allowed unless approved in writing prior to bidding.
  - 3. Flow-control sprinklers, with automatic open and shutoff feature.
  - 4. Flush ceiling sprinklers, including escutcheon, not allowed.
  - 5. Institution sprinklers, made with a small, breakaway projection.
  - 6. Pendent sprinklers.
  - 7. Pendent, dry-type sprinklers.
  - 8. Quick-response sprinklers.
  - 9. Sidewall sprinklers.
  - 10. Sidewall, dry-type sprinklers.
  - 11. Upright sprinklers.
- G. Sprinkler Finishes: Chrome plated, bronze, and painted.
- H. Special Coatings: Wax, lead, and corrosion-resistant paint.
- I. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.

1. Ceiling Mounting: Match Existing.
2. Sidewall Mounting: Match Existing

J. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

## 2.13 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm: Horn/Strobe, NEMA 3R minimum suitable for outdoor use.

1. Manufacturers:

- a. Potter Electric Signal Company.
- b. Safe Signal, formerly System Sensor.

C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers:

- a. ADT Security Services, Inc.
- b. Grinnell Fire Protection.
- c. ITT McDonnell & Miller.
- d. Potter Electric Signal Company.
- e. Safe Signal, formerly System Sensor.
- f. Viking Corp.
- g. Watts Industries, Inc.; Water Products Div.

D. Pressure Switch: UL 753, electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts, and design that operates on rising pressure and signals water flow.

1. Manufacturers:

- a. Grinnell Fire Protection.
- b. Potter Electric Signal Company.
- c. Safe Signal, formerly System Sensor.
- d. Viking Corp.

E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:

- a. McWane, Inc.; Kennedy Valve Div.
- b. Potter Electric Signal Company.
- c. Safe Signal, formerly System Sensor.

- F. Indicator-Post Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

1. Manufacturers:

- a. Potter Electric Signal Company.
- b. Safe Signal, formerly System Sensor.

2.14 PRESSURE GAGES

A. Manufacturers:

1. Brecco Corporation.
2. Dresser Equipment Group; Instrument Div.
3. Marsh Bellofram.
4. WIKA Instrument Corporation.

- B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.

1. Water System Piping: Include caption "WATER" or "AIR/WATER" on dial face.
2. Air System Piping: Include retard feature and caption "AIR" or "AIR/WATER" on dial face.

2.15 DOUBLE CHECK VALVE ASSEMBLIES

A. Manufacturers

1. Ames
2. Backflow Direct
3. Febco
4. Wilkins
5. Watts

- B. Description: Resilient seated, spring loaded with testable outlets provided, as required by Authorities Having Jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Obtain Engineer's Water Analysis or fire-hydrant flow test. Use results for system design calculations required in "Quality Assurance" Article in Part 1 of this Section.

3.2 EARTHWORK

- A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

### 3.3 EXAMINATION

- A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.
- B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.4 PIPING APPLICATIONS

- A. Shop weld pipe joints where welded piping is indicated.
- B. Do not use welded joints for galvanized-steel pipe.
- C. Flanges, flanged fittings, unions, nipples, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.
- D. Sprinkler Main Piping: Use the following:
  - 1. NPS 6 and Smaller: Standard-weight steel pipe with threaded ends, or grooved ends. No plain ends allowed.
  - 2. Outlets shall be welded.
    - a. Victaulic Brand Mechanical tee fittings may be used in lieu of welded outlets.
- E. Branch line piping: Use the following:
  - 1. NPS 1-1/4 and Smaller: Threadable steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints.
    - a. Victaulic Brand Mechanical tee fittings may be used
- F. Mains: Use the following:
  - 1. NPS 4 to NPS 6: Schedule 40 steel pipe with grooved ends & Welded outlets.
  - 2. NPS 3 and Smaller: Schedule 40 steel pipe with threaded ends, or grooved ends. No plain ends allowed.

### 3.5 VALVE APPLICATIONS

- A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:
  - 1. Fire-Protection-Service Valves: UL listed for applications where required by NFPA 13.
  - 2. General-Duty Valves: For applications where UL-listed valves are not required by NFPA 13.
    - a. Shutoff Duty: Use gate, ball, or butterfly valves.



- b. Throttling Duty: Use globe, ball, or butterfly valves.

### 3.6 JOINT CONSTRUCTION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping joint construction.
- B. Ductile-Iron-Piping, Grooved Joints: Use ductile-iron pipe with radius-cut-grooved ends; ductile-iron, grooved-end fittings; and ductile-iron, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions.
- C. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

### 3.7 WATER-SUPPLY CONNECTION

- A. Install shutoff Backflow preventions assemblies, valve, pressure gages, drain, and other accessories at connection to water service.

### 3.8 PIPING INSTALLATION

- A. Refer to Division 23 Section "Common Work Result for HVAC" for basic piping installation.
- B. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
  - 1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.
- C. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls. Refer to Division 23 Section "Common Work Result for HVAC."
- D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.
- E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.
- F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.
- G. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.
- H. Install sprinkler piping with drains for complete system drainage.

- I. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.
- J. Install alarm devices in piping systems.
- K. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.
  - 1. No powder driven studs allowed.
  - 2. Wrap-around braces are to be provided at end of branch lines.
- L. Earthquake Protection: Install piping according to NFPA 13-9.3 requirements, to protect from earthquake damage. Seismic Bracing shall be designed to withstand vertical forces and movement.
- M. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.
- N. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.
- O. When a fire pipe crosses a seismic expansion joint it shall have a Metraflex fire loop installed at the joint in accordance with NFPA 13 chapter 9.

### 3.9 SPECIALTY SPRINKLER FITTING INSTALLATION

- A. Install specialty sprinkler fittings according to manufacturer's written instructions.

### 3.10 VALVE INSTALLATION

- A. Refer to Division 23 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.
- B. Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.
- C. Double Check Valve Assemblies: Install valves in vertical up or horizontal position, per listings and for proper direction of flow.

### 3.11 SPRINKLER APPLICATIONS

- A. General: All sprinklers are to be quick response type. Sprinkler heads shall be of the latest design closed spray type for 155°F unless specified otherwise or required by code. Extended coverage heads shall not be used. Orifices larger than 1/2" may be used as required by density and spacing demands. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
2. Rooms with Ceilings: Match Existing.
3. Wall Mounting: Match Existing.
4. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.
5. Provide freeze proof type automatic sprinkler heads serving unconditioned spaces, areas subject to freezing and in other areas requiring their use.
6. Heads located within the air streams of unit heaters or other heat-emitting equipment shall be selected for proper temperature rating.

B. Sprinklers: Use the following:

1. All sprinklers shall be listed, quick response type.

### 3.12 SPRINKLER INSTALLATION

- A. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling with the ceiling grid if included, as well as lights, diffusers, and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads shall be symmetrical in all ceilings and all piping run parallel or perpendicular to building lines. Heads shall be linearly aligned in corridors.
  1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions and HVAC ductwork.
  2. Sprinkler heads shall not conflict with tile grids.
  3. Sprinkler heads shall be located near center of corridors.
- B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.
- C. Future finish shelled and tenant finish; Shell spaces shall be piped to accommodate future. Install sprinklers with 1" x 1/2" bushings, and space heads at a maximum spacing of 100 sq. ft. per head. Occupancy shall be Ordinary-Hazard Group 1 Design.

### 3.13 CONNECTIONS

- A. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.
- B. Electrical Connections: Power wiring is specified in Division 28.
- C. Connect alarm devices to fire alarm.

### 3.14 LABELING AND IDENTIFICATION

- A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Division 23 Section "Common Work Result for HVAC."

3.15 FIELD QUALITY CONTROL

- A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. When making a mechanical tee connection the coupon shall be attached at the mechanical tee.
- D. Report test results promptly and in writing to Architect and authorities having jurisdiction.
- E. Whether the underground serving the sprinkler system is done by this contractor or another, this contractor will be responsible to assure and have in his possession a certificate that the underground has been flushed and tested by the contractor who installed it in accordance with NFPA-24 prior to connection of the underground piping to the overhead sprinkler system.

3.16 CLEANING

- A. Clean dirt and debris from sprinklers.
- B. Remove and replace sprinklers having paint other than factory finish.

3.17 PROTECTION

- A. Protect sprinklers from damage until Substantial Completion.

3.18 COMMISSIONING

- A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.
- B. Verify that specified tests of piping are complete, and that "Material Test Certificates" are complete.
- C. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
- D. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.
- E. Verify that hose connections and fire department connections have threads compatible with local fire department equipment.
- F. Fill wet-pipe sprinkler piping with water.
- G. Fill standpipes with water.
- H. Verify that hose connections are correct type and size.

- I. Coordinate with fire alarm tests. Operate as required.

### 3.19 DEMONSTRATION & TESTS

- A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.
- B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi more than the normal pressure when the normal pressure is above 150 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.
- C. The local jurisdiction having authority and the Utah State Fire Marshal's office (where required) shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of underground, hydrostatic testing, or flow testing that may be required.
- D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead, backflow and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.
- E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

### 3.20 WARRANTY

- A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.
- B. Provide Operation and Maintenance Manuals with correct as-builts test certificates and warranties included. A minimum 6 sets to be provided in red 3-ring binders. Include a current adopted version of NFPA 25 softbound copy left with owner.
- C. Electronic copy of AutoCAD as-built drawings shall also be provided on CD, with each O&M Manual.

### 3.21 FIELD QUALITY CONTROL

- A. Flush, test and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.
- B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance. Repeat procedure until satisfactory results are obtained.
- C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

END OF SECTION 21 1000

## SECTION 22 0500 - COMMON WORK RESULTS FOR PLUMBING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. D 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. Piping materials and installation instructions common to most piping systems.
  - 2. Transition fittings.
  - 3. Dielectric fittings.
  - 4. Escutcheons.
  - 5. Painting and finishing.
  - 6. Link Seal

#### 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, and crawlspaces.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms, accessible pipe shafts, accessible plumbing chases and accessible tunnels.
- 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 rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.

#### 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

#### 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 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."

### 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. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- C. 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.

## 2.4 TRANSITION FITTINGS

- A. Flexible Transition Couplings for Underground Nonpressure 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.
  - 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 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.
  - E. 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: Stainless steel. Include two 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 waterstop, unless otherwise indicated.

- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.

- 1. Underdeck Clamp: Clamping ring with set screws.

- E. Molded 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, Floor-Plate Type: Cast-iron floor plate.
- D. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

## 2.9 LINK SEAL

- A. Link-Seal® Modular Seal Pressure Plates

- 1. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
    - a. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
    - Flexural Strength @ Yield = 30,750 psi per ASTM D-790
    - Flexural Modulus = 1,124,000 psi per ASTM D-790
    - Elongation Break = 11.07% per ASTM D-638
    - Specific Gravity = 1.38 per ASTM D-792
  - 2. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
  - 3. For fire and Hi-Temp service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.
  - 4. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be: 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

## PART 3 - EXECUTION

### 3.1 PLUMBING DEMOLITION

- A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.
  - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
  - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
- B. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

### 3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are 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.
2. Existing Piping: Use the following:
  - a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
  - b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
  - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
  - e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
- M. 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.
- N. 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.

### 3.3 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.

### 3.4 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. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

### 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 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.
- C. Field Welding: Comply with AWS D1.1.

### 3.7 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor plumbing materials.

- 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.

END OF SECTION 22 0500

## SECTION 22 0518 - ESCUTCHEONS FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Escutcheons.

#### 1.3 ACTION SUBMITTALS

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

### PART 2 - PRODUCTS

#### 2.1 ESCUTCHEONS

- A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.
- C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.
- B. Install escutcheons with ID to 2 inch (50mm), tube, and insulation of insulated piping and with OD that completely covers opening.
  - 1. Escutcheons for New Piping:



- a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type with polished, chrome-plated finish.
- b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
- c. Insulated Piping: One-piece, stamped-steel type with chrome-plated finish
- d. Bare Piping 2 inch and Smaller at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- e. Bare Piping Larger than 2 inch at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish
- f. Bare Piping 2 inch and Smaller at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
- g. Bare Piping Larger than 2 inch at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type with polished, chrome-plated finish
- h. Bare Piping 2 inch and Smaller in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.
- i. Bare Piping Larger than 2 inch in Unfinished Service Spaces: One-piece, stamped-steel type with polished, chrome-plated finish
- j. Bare Piping 2 inch and Smaller in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated or rough-brass finish.

### 3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 220518

## SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Bronze ball valves.
- B. Related Sections:
  - 1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
  - 2. Division 22 Section "Identification for Plumbing Piping " for valve tags and schedules.

#### 1.3 DEFINITIONS

- A. CWP: Cold working pressure.
- B. EPDM: Ethylene propylene copolymer rubber.
- C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
- D. NRS: Nonrising stem.
- E. OS&Y: Outside screw and yoke.
- F. RS: Rising stem.
- G. SWP: Steam working pressure.

#### 1.4 SUBMITTALS

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

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threaded ends.
3. Set ball valves open to minimize exposure of functional surfaces.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:

1. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

F. Valve-End Connections:

1. Solder Joint: With sockets according to ASME B16.18.
2. Threaded: With threads according to ASME B1.20.1.

## 2.2 BRONZE BALL VALVES

### A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. American Valve, Inc.
  - b. Conbraco Industries, Inc.; Apollo Valves.
  - c. Crane Co.; Crane Valve Group; Crane Valves.
  - d. Hammond Valve.
  - e. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - f. Milwaukee Valve Company.
  - g. NIBCO INC.
  - h. Red-White Valve Corporation.
  - i. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

### B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Crane Co.; Crane Valve Group; Crane Valves.
  - c. Hammond Valve.
  - d. Lance Valves; a division of Advanced Thermal Systems, Inc.
  - e. Milwaukee Valve Company.
  - f. NIBCO INC.
  - g. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Two piece.
  - e. Body Material: Bronze.

- f. Ends: Threaded.
- g. Seats: PTFE or TFE.
- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.
- j. Port: Full.

C. Three-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. DynaQuip Controls.
  - c. Hammond Valve.
  - d. Milwaukee Valve Company.
  - e. NIBCO INC.
  - f. Red-White Valve Corporation.
- 2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Three piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.
  - h. Stem: Bronze.
  - i. Ball: Chrome-plated brass.
  - j. Port: Full.

D. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.; Apollo Valves.
  - b. Hammond Valve.
  - c. Milwaukee Valve Company.
  - d. NIBCO INC.
- 2. Description:
  - a. Standard: MSS SP-110.
  - b. SWP Rating: 150 psig.
  - c. CWP Rating: 600 psig.
  - d. Body Design: Three piece.
  - e. Body Material: Bronze.
  - f. Ends: Threaded.
  - g. Seats: PTFE or TFE.

- h. Stem: Stainless steel.
- i. Ball: Stainless steel, vented.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves.

#### 3.2 VALVE INSTALLATION

- A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- B. Locate valves for easy access and provide separate support where necessary.
- C. Install valves in horizontal piping with stem at or above center of pipe.
- D. Install valves in position to allow full stem movement.

#### 3.3 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

#### 3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valve applications are not indicated, use the following:
  - 1. Shutoff Service: Ball valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

### 3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.
2. Ball Valves: One, Two or Three piece, full or, regular port, bronze with bronze or stainless-steel trim.

END OF SECTION 220523

## SECTION 22 0529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following hangers and supports for plumbing system piping and equipment:
  - 1. Steel pipe hangers and supports.
  - 2. Metal framing systems.
  - 3. Thermal-hanger shield inserts.
  - 4. Fastener systems.
  - 5. Pipe stands.
  - 6. Pipe positioning systems.

#### 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.

#### 1.5 SUBMITTALS

- A. Product Data: For the following:
  - 1. Steel pipe hangers and supports.
  - 2. Thermal-hanger shield inserts.
  - 3. Powder-actuated fastener systems.
  - 4. Pipe positioning systems.
  - 5. Mechanical Anchors: ICC-ES Evaluation Reports validating 'Cracked Concrete' testing per A.C. 193 must be provided for anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems.



- B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following:
  - 1. Metal framing systems. Include Product Data for components.
  - 2. Pipe stands. Include Product Data for components.
- C. Welding certificates.

## 1.6 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel.", AWS D1.4, "Structural Welding Code--Reinforcing Steel." and 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. AWS D1.2, "Structural Welding Code--Aluminum."
  - 3. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
  - 4. ASME Boiler and Pressure Vessel Code: Section IX.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

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

### 2.2 STEEL PIPE HANGERS AND SUPPORTS

- A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.
- B. Manufacturers:
  - 1. Anvil International.
  - 2. AAA Technology & Specialties Co., Inc.
  - 3. Bergen-Power Pipe Supports.
  - 4. B-Line Systems, Inc.; a division of Cooper Industries.
  - 5. Carpenter & Paterson, Inc.
  - 6. Empire Industries, Inc.
  - 7. ERICO/Michigan Hanger Co.
  - 8. FNW/Ferguson Enterprises

9. Globe Pipe Hanger Products, Inc.
10. Grinnell Corp.
11. GS Metals Corp.
12. National Pipe Hanger Corporation.
13. PHD Manufacturing, Inc.
14. PHS Industries, Inc.
15. Piping Technology & Products, Inc.
16. Tolco Inc.
17. Simpson Strong-Tie Co.

C. Galvanized, Metallic Coatings: Pregalvanized 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.

## 2.3 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

1. Anvil International.
2. B-Line Systems, Inc.; a division of Cooper Industries.
3. ERICO/Michigan Hanger Co.; ERISTRUT Div.
4. FNW/Ferguson Enterprises
5. GS Metals Corp.
6. Hilti, Inc.
7. Power-Strut Div.; Tyco International, Ltd.
8. Thomas & Betts Corporation.
9. Tolco Inc.
10. 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. Manufacturers:

1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.

3. PHS Industries, Inc.
  4. Pipe Shields, Inc.
  5. Rilco Manufacturing Company, Inc.
  6. Value Engineered Products, Inc.
- C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.
- D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate.
- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
    - a. Hilti, Inc.
    - b. MKT Fastening, LLC.
    - c. Powers Fasteners.
    - d. Simpson Strong-Tie Co.
- B. Mechanical-Expansion Anchors and Concrete Screws: Insert-wedge-type 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. For anchors resisting seismic loads and/or supporting life- safety systems including fire sprinkler systems, Anchors shall have been tested for 'Cracked Concrete' per A.C. 193 per a valid ICC-ES Evaluation Report. Manufacturers with these anchors have been designated below with: '\*'
1. Manufacturers:
    - a. B-Line Systems, Inc.; a division of Cooper Industries.
    - b. Empire Industries, Inc.
    - c. Hilti, Inc.
    - d. ITW Ramset/Red Head.
    - e. MKT Fastening, LLC.
    - f. Powers Fasteners.
    - g. Simpson Strong-Tie Co. \*

## 2.6 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. Manufacturers:
  - 1. C & S Mfg. Corp.
  - 2. HOLDRITE Corp.; Hubbard Enterprises.
  - 3. Samco Stamping, Inc.

## 2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

# 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 noninsulated 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 noninsulated stationary pipes, NPS 3/4 to NPS 8.
  7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
  10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
  11. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
  12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or
  13. 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.
- 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 Weldless 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 or Simpson Blue Banger Concrete insert with UL & FM approvals): 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-joint 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.
- L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.
- M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

- N. 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. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. 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.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
  - 1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions. For anchors resisting seismic loads and/or supporting life-safety systems including fire sprinkler systems, anchors shall have been tested for 'Cracked Concrete' per A.C. 193 and shall have a valid ICC-ES Evaluation Report
- F. 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.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install lateral bracing with pipe hangers and supports to prevent swaying.
- I. 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.
- J. 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.

3. 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.
4. Insert Material: Length at least as long as protective shield.
5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.3 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 .

### 3.4 PAINTING

- A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
  1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.
- B. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 22 0529



## SECTION 22 0719 - PLUMBING PIPING 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 insulating the following plumbing piping services:
  - 1. Domestic cold-water piping.
  - 2. Domestic hot-water piping.
  - 3. Supplies and drains for handicap-accessible lavatories and sinks.

#### 1.3 DEFINITIONS:

- A. Refer to Section 220500 "Common Work Results for Plumbing".

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
  - 2. Detail insulation application at elbows, fittings, valves, and specialties for each type of insulation.
  - 3. Detail removable insulation at piping specialties, connections, and access panels.
  - 4. Detail application of field-applied jackets.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. 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.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
  - 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.9 SCHEDULING

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

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule,"
- B. Insulation for below-ambient service requires a vapor-barrier.

- 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 C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Aeroflex USA, Inc.; Aerocel.
    - b. Armacell LLC; AP Armaflex.
    - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- H. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553:
  - 1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 2. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- I. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Fibrex Insulations Inc.; Coreplus 1200.
    - b. Johns Manville; Micro-Lok.
    - c. Knauf Insulation; 1000-Degree Pipe Insulation.
    - d. Manson Insulation Inc.; Alley-K.
    - e. Owens Corning; Fiberglas Pipe Insulation.
  - 2. Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A,
    - a. **Without factory-applied jacket** with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- J. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.
- B. Flexible Elastomeric 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 LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.
  - 2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- D. ASJ Adhesive, and FSK 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-20.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. PVC Jacket Adhesive: Compatible with PVC jacket.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Dow Corning Corporation; 739, Dow Silicone.
    - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
    - c. P.I.C. Plastics, Inc.; Welding Adhesive.
    - d. Speedline Corporation; Polyco VP Adhesive.
  2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, 0.013 perm at 43-mil dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F .
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
    - b. Eagle Bridges - Marathon Industries; 501.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
    - d. Mon-Eco Industries, Inc.; 55-10.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
  3. Service Temperature Range: 0 to 180 deg F .
  4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
  5. Color: White.
- D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
  3. Service Temperature Range: Minus 50 to plus 220 deg F .
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
    - d. Mon-Eco Industries, Inc.; 55-50.
    - e. Vimasco Corporation; WC-1/WC-5.
  2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
  3. Service Temperature Range: Minus 20 to plus 180 deg F .
  4. Solids Content: 60 percent by volume and 66 percent by weight.
  5. Color: White.

## 2.5 SEALANTS

### A. ASJ Flashing Sealants, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.7 FIELD-APPLIED JACKETS

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

## 2.8 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. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: 3 inches.
  3. Thickness: 11.5 mils.
  4. Adhesion: 90 ounces force/inch in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: 40 lbf/inch in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: 2 inches.
  3. Thickness: 6 mils.
  4. Adhesion: 64 ounces force/inch in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: 18 lbf/inch in width.

## 2.9 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

## 2.10 PROTECTIVE SHIELDING GUARDS

- A. Protective Shielding Pipe Covers:
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
    - a. Engineered Brass Company.
    - b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
    - c. McGuire Manufacturing.
    - d. Plumberex.
    - e. Truebro; a brand of IPS Corporation.
    - f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.



2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.
- B. Protective Shielding Piping Enclosures:
1. Manufacturers: Subject to compliance with requirements provide products by one of the following:
    - a. Truebro; a brand of IPS Corporation.
    - b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
  2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

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

#### 3.2 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 piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
  - 1. Draw jacket tight and smooth.
  - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
  - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at:
    - a. **2 inches** o.c.
    - b. For below-ambient services, apply vapor-barrier mastic over staples.
  - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
  - 1. Vibration-control devices.
  - 2. Testing agency labels and stamps.
  - 3. Nameplates and data plates.
  - 4. 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 Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
  - 1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
  - 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  - 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  - 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
  - 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
  - 6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  - 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for

- above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
  2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
  3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
  4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
  5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

- 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 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.
- C. 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. 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.

### 3.7 INSTALLATION OF MINERAL-FIBER INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe 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.

#### C. 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.

### 3.8 FIELD-APPLIED JACKET INSTALLATION

#### A. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- B. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

### 3.9 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. Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).
- C. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.10 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Cold Water:
  - 1. **NPS 1-1/2** and Smaller: Insulation shall be one of the following;
    - a. Flexible Elastomeric:
      - 1) **1 inch** thick
    - b. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      - 1) **1 inch** thick
- B. Domestic Hot Water:
  - 1. **NPS 1-1/2** and Smaller: Insulation shall be **one of** the following:
    - a. Mineral-Fiber, Preformed Pipe Insulation, Type I:
      - 1) 1 inch thick.

### 3.11 INDOOR, FIELD-APPLIED JACKET SCHEDULE

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

1. None.
  2. **PVC:**
    - a. White: 20 mils thick
- D. Piping, Exposed:
1. **PVC:**
    - a. White: **30 mils thick**

END OF SECTION 22 0719



## SECTION 22 1116 - 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. Aboveground domestic water pipes, tubes, and fittings inside buildings.

#### 1.3 FIELD 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 Construction Manager or owner no fewer than two days in advance of proposed interruption of water service.

### PART 2 - PRODUCTS

#### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.
- B. Potable-water piping and components shall comply with NSF 14 and NSF 61.
- C. All piping shall be American made and tested; no import pipe will be permitted.

#### 2.2 COPPER TUBE AND FITTINGS

- A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.
- B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Copper Pressure-Seal-Joint Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. NIBCO Inc.
  - b. Viega.
2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

- A. Solder Filler Metals: ASTM B 32, lead-free alloys.
- B. Flux: ASTM B 813, water flushable.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

3.2 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. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."
- E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

### 3.3 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.

### 3.4 PIPING SCHEDULE

- A. Aboveground domestic water piping, NPS 2 and smaller shall be one of the following:
  - 1. Hard copper tube, ASTM B 88, Type L; cast- copper, solder-joint fittings; and soldered joints.
  - 2. Hard copper tube, ASTM B 88, Type L; copper pressure-seal-joint fittings; and pressure-sealed joints.

END OF SECTION 22 1116

## SECTION 22 1119 - DOMESTIC WATER PIPING SPECIALTIES

### 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 domestic water piping specialties:
  - 1. Vacuum breakers.
  - 2. Backflow preventers.
- B. Related Sections include the following:
  - 1. Division 22 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Diagram power, signal, and control wiring.

- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For domestic water piping specialties 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.
- B. NSF Compliance:
  - 1. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic domestic water piping components.
  - 2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

## PART 2 - PRODUCTS

### 2.1 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Ames Co.
    - b. Cash Acme.
    - c. Conbraco Industries, Inc.
    - d. FEBCO; SPX Valves & Controls.
    - e. Rain Bird Corporation.
    - f. Toro Company (The); Irrigation Div.
    - g. Watts Industries, Inc.; Water Products Div.
    - h. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1001.
3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
4. Body: Bronze.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Arrowhead Brass Products, Inc.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. MIFAB, Inc.
  - e. Prier Products, Inc.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Woodford Manufacturing Company.
  - h. Zurn Plumbing Products Group; Light Commercial Operation.
  - i. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1011.
3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Ames Co.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.

- d. Flomatic Corporation.
  - e. Toro Company (The); Irrigation Div.
  - f. Watts Industries, Inc.; Water Products Div.
  - g. Zurn Plumbing Products Group; Wilkins Div.
- 2. Standard: ASSE 1020.
- 3. Operation: Continuous-pressure applications.
- 4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
- 5. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

D. Spill-Resistant Vacuum Breakers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Conbraco Industries, Inc.
  - b. Watts Industries, Inc.; Water Products Div.
- 2. Standard: ASSE 1056.
- 3. Operation: Continuous-pressure applications.
- 4. Accessories:
  - a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Dual-Check-Valve Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. FEBCO; SPX Valves & Controls.
  - d. Flomatic Corporation.
  - e. Ford Meter Box Company, Inc. (The).
  - f. Honeywell Water Controls.
  - g. McDonald, A. Y. Mfg. Co.
  - h. Mueller Co.; Water Products Div.
  - i. Watts Industries, Inc.; Water Products Div.
  - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1024.
3. Operation: Continuous-pressure applications.
4. Body: Bronze with union inlet.



## 2.3 TEMPERATURE-ACTUATED WATER MIXING VALVES

### A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong International, Inc.
  - b. Cash Acme.
  - c. Conbraco Industries, Inc.
  - d. Honeywell Water Controls.
  - e. Leonard Valve Company.
  - f. Powers; a Watts Industries Co.
  - g. Symmons Industries, Inc.
  - h. Taco, Inc.
  - i. Watts Industries, Inc.; Water Products Div.
  - j. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded union inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Valve Finish: Rough bronze.

B. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Cash Acme.
  - b. Conbraco Industries, Inc.
  - c. Honeywell Water Controls.
  - d. Lawler Manufacturing Company, Inc.
  - e. Leonard Valve Company.
  - f. Powers; a Watts Industries Co.
  - g. Watts Industries, Inc.; Water Products Div.
  - h. Zurn Plumbing Products Group; Wilkins Div.
2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

## 2.4 WATER HAMMER ARRESTERS

### A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. AMTROL, Inc.
  - b. Josam Company.
  - c. MIFAB, Inc.
  - d. PPP Inc.
  - e. Sioux Chief Manufacturing Company, Inc.
  - f. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - g. Tyler Pipe; Wade Div.
  - h. Watts Drainage Products Inc.
  - i. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows or Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

## PART 3 - EXECUTION

### 3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
  1. Install thermometers and water regulators if specified.
  2. Install cabinet-type units recessed in or surface mounted on wall as specified.

- C. Install water hammer arresters in water piping according to PDI-WH 201.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

### 3.3 FIELD QUALITY CONTROL

- A. Perform the following tests and prepare test reports:
  - 1. Test each backflow preventer according to authorities having jurisdiction and the device's reference standard.
- B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

### 3.4 ADJUSTING

- A. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 22 1119

## SECTION 22 1316 - 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. Section Includes:
  - 1. Pipe, tube, and fittings.
  - 2. Specialty pipe fittings.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
  - 1. Soil, Waste, and Vent Piping: 10-foot head of water.

#### 1.4 ACTION SUBMITTALS

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

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
  - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
  - 2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
- B. Field quality-control reports.

#### 1.6 QUALITY ASSURANCE

- A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

- B. Comply with NSF/ANSI 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-sewer" for plastic sewer piping; "NSF-drain" for plastic drain piping, and "NSF-tubular" for plastic continuous waste piping.

## PART 2 - PRODUCTS

### 2.1 PIPING MATERIALS

- A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

### 2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Pipe and Fittings: All cast-iron waste, vent and sewer pipe and fittings shall conform to the requirements of CISPI Standard 301 and ASTM A 888. All products shall be marked with the collective trademark of the Cast Soil Pipe Institute and shall be listed by NSF International or receive prior approval of the engineer. All cast-iron pipe and fittings shall be American made and tested. Non-compliant import cast-iron products will not be permitted. Any non-compliant cast-iron product installed by the contractor on this project will be replaced at the contractor's expense and shall include all repairs, patching, painting and other incidental work required to return the project to its pre-remediation state.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. AB&I Foundry
    - b. Charlotte Pipe
    - c. Tyler Pipe

- B. CISPI, Hubless-Piping Couplings:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. ANACO.
    - b. Ideal
    - c. Mission Rubber Company; a division of MCP Industries, Inc.
    - d. Tyler Pipe.

- 2. Standards: ASTM C 1277 and CISPI 310.
  - 3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
  - 4. Listing: Couplings shall be listed by NSF International. Each coupling shall be embossed with the NSF seal.

- C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Husky SD 4000.
  - b. Clamp-All Corp HI-TORQ 125.
2. Standards: ASTM C 1277 and ASTM C 1540.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

### 2.3 PVC PIPE AND FITTINGS

- A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
- B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
- C. Adhesive Primer: ASTM F 656.
  1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
  2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- D. Solvent Cement: ASTM D 2564.
  1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## PART 3 - EXECUTION

### 3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Division 31 Section "Earth Moving."

### 3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping 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.

- C. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- D. Install piping to permit valve servicing.
- E. Install piping at indicated slopes.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install piping to allow application of insulation.
- I. Install seismic restraints on piping. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping."
- J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
- L. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
  - 1. Building Sanitary Drain: 2 percent downward in direction of flow for piping.
  - 2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
  - 3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.
- M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
  - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- N. Install underground PVC piping according to ASTM D 2321.
- O. Plumbing Specialties:



1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Comply with requirements for cleanouts specified in Division 22 Section "Sanitary Waste Piping Specialties."
  2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- P. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- Q. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- R. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."
- S. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 22 Section "Escutcheons for Plumbing Piping."

### 3.3 JOINT CONSTRUCTION

- A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Plastic, Nonpressure-Piping, Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
  2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with requirements for seismic-restraint devices specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Division 22 Section "Hangers and Supports for Plumbing Piping."
1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
  2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
  3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
  4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
  5. Vertical Piping: MSS Type 8 or Type 42, clamps.
  6. Install individual, straight, horizontal piping runs:
    - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.

7. Base of Vertical Piping: MSS Type 52, spring hangers.
- C. Support horizontal piping and tubing within 12 inches of each fitting and coupling or valve and coupling.
- D. Support vertical piping and tubing at base and at each floor.
- E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
- F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
  1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
  2. NPS 3: 60 inches with 1/2-inch rod.
  3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
  4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
  5. NPS 10 and NPS 12: 60 inches with 7/8-inch rod.
  6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.
- G. Install supports for vertical cast-iron soil piping every 15 feet.
- H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

### 3.5 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: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
  3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
  4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
  5. Comply with requirements for cleanouts and drains specified in Division 22 Section "Sanitary Waste Piping Specialties."
- D. Make fixture and equipment 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.

### 3.6 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 22 Section "Identification for Plumbing Piping."

### 3.7 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
  1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
  2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
  1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
  2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
  3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
  4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
  5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
  6. Prepare reports for tests and required corrective action.

### 3.8 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

### 3.9 PIPING SCHEDULE

- A. Aboveground, soil and waste piping NPS 3 and smaller shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- B. Aboveground, vent piping NPS 3 and smaller shall be the following:
  - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Underground, soil, waste, and vent piping NPS 3 and smaller shall be any of the following:
  - 1. Hubless, cast-iron soil pipe and fittings CISPI hubless-piping couplings; and coupled joints.
  - 2. Solid-wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
  - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 22 1316

## SECTION 22 1319 - SANITARY WASTE PIPING SPECIALTIES

### 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 sanitary drainage piping specialties:
  - 1. Cleanouts.
  - 2. Through-penetration firestop assemblies.
  - 3. Miscellaneous sanitary drainage piping specialties.
- B. Related Sections include the following:
  - 1. Division 22 Section "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

#### 1.3 DEFINITIONS

- A. FOG: Fats, oils, and greases.
- B. FRP: Fiberglass-reinforced plastic.
- C. HDPE: High-density polyethylene plastic.
- D. PE: Polyethylene plastic.

- E. PP: Polypropylene plastic.
- F. PVC: Polyvinyl chloride plastic.

#### 1.4 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

### PART 2 - PRODUCTS

#### 2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Josam Company; Josam Div.
    - b. MIFAB, Inc.
    - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
    - d. Tyler Pipe; Wade Div.
    - e. Watts Drainage Products Inc.
    - f. Zurn Plumbing Products Group; Specification Drainage Operation.
    - g. Sun Drainage Products
  - 2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
  - 3. Size: Same as connected drainage piping
  - 4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
  - 5. Closure: Countersunk, brass plug.
  - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. Oatey.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Light Commercial Operation.
  - g. Zurn Plumbing Products Group; Specification Drainage Operation.
  - h. Sun Drainage Products
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with tapered threads.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Josam Company; Josam Div.
  - b. MIFAB, Inc.
  - c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
  - d. Tyler Pipe; Wade Div.
  - e. Watts Drainage Products Inc.
  - f. Zurn Plumbing Products Group; Specification Drainage Operation.
  - g. Sun Drainage Products
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub-and-spigot, cast-iron soil pipe T-branch as required to match connected piping.
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round, stainless-steel wall-installation frame and cover.

2.2 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:



- a. ProSet Systems Inc.
- 3. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
- 4. Size: Same as connected soil, waste, or vent stack.
- 5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
- 6. Stack Fitting: ASTM A 48/A 48M, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
- 7. Special Coating: Corrosion resistant on interior of fittings.

## 2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

### A. Deep-Seal Traps:

- 1. Size: Same as connected waste piping.
  - a. NPS 2: 4-inch- minimum water seal.
  - b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

### B. Air-Gap Fittings:

- 1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
- 2. Body: Bronze or cast iron.
- 3. Inlet: Opening in top of body.
- 4. Outlet: Larger than inlet.
- 5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

### C. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch > above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

D. Stack Flashing Fittings:

1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
2. Size: Same as connected stack vent or vent stack.

E. Vent Cap Filters:

1. Description: Activated carbon filter in housing for installation at vent terminal as manufactured by Sweet Filter.
2. Size: Same as connected stack vent or vent stack.

## 2.4 FLASHING MATERIALS

- A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
  1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
  2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
  3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.
- B. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.
- C. Fasteners: Metal compatible with material and substrate being fastened.

- D. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- E. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping."
- B. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
  - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
  - 2. Locate at each change in direction of piping greater than 45 degrees.
  - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
  - 4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

- G. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- H. Install wood-blocking reinforcement for wall-mounting-type specialties.
- I. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- J. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

### 3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment to allow service and maintenance.

### 3.3 FIELD QUALITY CONTROL

- A. Perform tests and inspections and prepare test reports.
- B. Tests and Inspections:
  - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
  - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

## SECTION 224000 - 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.

#### 1.2 SUMMARY

- A. This Section includes the following conventional plumbing fixtures and related components:
  - 1. Faucets for Sinks.
  - 2. Protective shielding guards.
  - 3. Fixture supports.
- B. Related Sections include the following:
  - 1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

#### 1.3 DEFINITIONS

- A. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.
- B. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.
- C. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.
- D. 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, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.
- E. FRP: Fiberglass-reinforced plastic.
- F. PMMA: Polymethyl methacrylate (acrylic) plastic.
- G. PVC: Polyvinyl chloride plastic.
- H. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.
- D. Warranty: Special warranty specified in this Section.

#### 1.5 QUALITY ASSURANCE

- A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
  - 1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.
- D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.
- E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.
- F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.
- G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
  - 1. Stainless Steel.
- H. Comply with the following applicable standards and other requirements specified for sink faucets:
  - 1. Backflow Protection Devices for Faucets with Side Spray: ASME A112.18.3M.

2. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
3. Faucets: ASME A112.18.1.
4. Hose-Connection Vacuum Breakers: ASSE 1011.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. NSF Potable-Water Materials: NSF 61.
8. Pipe Threads: ASME B1.20.1.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.
12. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

- I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:

1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Plastic Tubular Fittings: ASTM F 409.
4. Brass Waste Fittings: ASME A112.18.2.
5. NSF61 Appendage G-AB 1953. Lead free potable drinking faucets.

- J. Comply with the following applicable standards and other requirements specified for miscellaneous components:

1. Flexible Water Connectors: ASME A112.18.6.
2. Grab Bars: ASTM F 446.
3. Hose-Coupling Threads: ASME B1.20.7.
4. Off-Floor Fixture Supports: ASME A112.6.1M.
5. Pipe Threads: ASME B1.20.1.

## 1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
3. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.

## PART 2 - PRODUCTS

### 2.1 SINK FAUCETS

- A. Sink Faucets:



1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Chicago Faucets.
  - b. T & S Brass and Bronze Works, Inc.
  - c. Moen, Inc.

## 2.2 FIXTURE SUPPORTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of 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.
  7. Sun Drainage Products

## 2.3 COMMERCIAL SINKS

- A. Commercial Sinks:
  1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Acorn-Sinks Co.
    - b. Elkay Manufacturing Co.
    - c. Just Manufacturing Company.

## 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 without waste fitting for fixtures with tubular waste piping.
  - 2. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.
- C. Install wall-mounting fixtures with tubular waste piping attached to supports.
- D. Install counter-mounting fixtures in and attached to casework.
- E. Install fixtures level and plumb according to roughing-in drawings.
- F. 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 valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."
- G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.
- H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.
- I. 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.
- J. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.
- K. 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.
- L. Install traps on fixture outlets.
  - 1. Exception: Omit trap on fixtures with integral traps.
  - 2. Exception: Omit trap on indirect wastes, unless otherwise indicated.
- M. 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."
- N. 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."

- U. All plumbing fixtures are to be mounted at the height specified on the Architectural drawings.

### 3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

### 3.4 FIELD QUALITY CONTROL

- A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.
- B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.
- C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.
- D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

### 3.5 ADJUSTING

- A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.
- B. Adjust water pressure at faucets to produce proper flow and stream.
- C. Replace washers and seals of leaking and dripping faucets and stops.

### 3.6 CLEANING

- A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
  - 1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
- 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.

3.8 PLUMBING FIXTURE SCHEDULE (See Plumbing Fixture Schedule for Fixture Descriptions)

END OF SECTION 22 4000

## SECTION 23 0100 - MECHANICAL REQUIREMENTS

### PART 1 - GENERAL

#### 1.1 GENERAL CONDITIONS

- A. The General Conditions of the Contract, with the amendments, supplements, forms and requirements in Division 1, and herewith made a part of this Division.
- B. All sections of Division 21, 22 & 23 shall comply with the Mechanical General Requirements. The standards established in this section as to quality of materials and equipment, the type and quality of workmanship, mode of operations, safety rules, code requirements, etc., shall apply to all sections of this Division as though they were repeated in each Division.

#### 1.2 SCOPE OF WORK

- A. The project described herein is the Indian Hills Middle School Remodel. This work shall include all labor, materials, equipment, fixtures, and devices for the entire mechanical work and a complete operating and tested installation as required for this project.
- B. This Division will schedule the boiler inspection and pay for all costs associated with certifying the boiler with the state.

#### 1.3 CODES & ORDINANCES

- A. All work shall be executed in accordance with all underwriters, public utilities, local and state rules and regulations applicable to the trade affected. Should any change in the plans and Specifications be required to comply with these regulations, the Contractor shall notify the Architect before the time of submitting his bid. After entering into contract, the Contractor will be held to complete all work necessary to meet these requirements without extra expense to the Owner. Where work required by drawings or specifications is above the standard required, it shall be done as shown or specified.
- B. Applicable codes:
  - International Building code- 2015 Edition
  - International Mechanical Code- 2015 Edition
  - International Plumbing Code- 2015 Edition
  - International Fire Code- 2015 Edition
  - International Energy code – 2015 Edition
  - International Fuel Gas Code – 2015 Edition
  - National Electrical Code – 2011 Edition
  - Utah Boiler and Pressure Vessel Rules and Regulations – 2013 Edition

#### 1.4 INDUSTRY STANDARDS

A. All work shall comply with the following standards.

1. Associated Air Balance council (AABC)
2. Air Conditioning and Refrigeration Institute (ARI)
3. Air Diffusion council (ADC)
4. Air Movement and Control Association (AMCA)
5. American Gas Association (AGA)
6. American National Standards Institute (ANSI)
7. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
8. American Society of Mechanical Engineers (ASME)
9. American Society of Testing Materials (ASTM)
10. American Water Works Association (AWWA)
11. Cooling Tower Institute (CTI)
12. ETL Testing Laboratories (ETL)
13. Institute of Electrical and Electronic Engineers (IEEE)
14. Hydronics Institute (HI)
15. Manufacturers Standardization Society of the Valve and Fitting Industry (MSS)
16. National Fire Protection Association (NFPA)
17. National Electrical Code (NEC)
18. National Electrical Manufacturers Association (NEMA)
19. National Electrical Safety code (NESC)
20. Utah safety Standard (OSHA), Utah State Industrial Council.
21. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
22. Underwriters Laboratories (UL)
23. Tubular Exchanger Manufacturers Association, Inc. (TEMA)
24. Heat Exchanger Institute (HEI)
25. Hydraulic Institute (HI)
26. Thermal Insulation Manufacturer's Association (TIMA)
27. Scientific Apparatus Makers Association (SAMA)

B. Compliance Verification:

1. All items required by code or specified to conform to the ASME code shall be stamped with the ASME seal.
2. Form U-1, the manufacturer's data report for pressure vessels, is to be included in the Operation and Maintenance Manuals. National Board Register (NBR) numbers shall be provided where required by code.
3. Manufactured equipment which is represented by a UL classification and/or listing, shall bear the UL or equivalent ETL label.

#### 1.5 UTILITIES & FEES

- A. All fees for permits required by this work will be paid by this division. The contractor shall obtain the necessary permits to perform this work. Unless noted otherwise, all systems furnished and or installed by this Contractor, shall be complete with all utilities, components, commodities and accessories required for a fully functioning system. This Contractor shall furnish smoke

generators when required for testing, furnish glycol for glycol piping systems, full load of salt to fill brine tank for water softening system, furnish cleaners and water treatment additives.

## 1.6 SUBMITTALS AND SHOP DRAWINGS

- A. Submittals: As soon as possible after the contract is awarded, but in no case more than 45 calendar days thereafter, the Contractor shall submit to the Architect six (6) copies of the descriptive literature covering products and materials to be used in the installation of mechanical systems for this project. The review of the submitted data will require a minimum of 14 days. The first day starts after the day they are received in the engineers office to which the project is being constructed from. If the Contractors schedule requires return of submitted literature in less than the allotted time, the Contractor shall accelerate his submittal delivery date. The Contractor shall resubmit all items requiring re-review within 14 days of returned submittals. Refer to each specification section for items requiring submittal review. Written approval of the Owner's Representative shall be obtained before installing any such equipment or materials for the project. The submittals shall be prepared in an orderly manner, contained in a 3-ring loose-leaf binder with index and identification tabs each item or group of items and for each specification section. All items shall be submitted at one time except automatic temperature control drawings and seismic restraint drawings which may be submitted separately within 120 days of the contract award date. Partial submittals will not be reviewed until the complete submittal is received.

Submitted literature shall bear the Contractor's stamp, indicating that he has checked all equipment being submitted; that each item will fit into the available space with the accesses shown on the drawings; and, further, that each item conforms to the capacity and quality standards given in the contract documents.

Submitted literature shall clearly indicate performance, quality, and utility requirements; shall show dimension and size of connection points; and shall include derating factors that were applied for each item of equipment to provide capacity at job site elevation. Temperature control submittals shall include piping and wiring diagrams, sequence of operation and equipment. Equipment must fit into the available space with allowance for operation, maintenance, etc. Factory piped and wired equipment shall include shop drawings for all internal wiring and piping furnished with the unit.

Submitted literature shall clearly show all required field install wiring, piping, and accessory installations required by the Contractor to provide a complete operating system.

Review by the Owner's Representative is for general conformance of the submitted equipment to the project specification. In no way does such review relieve this Contractor of his obligation to furnish equipment and materials that comply in detail to the specification nor does it relieve the Contractor of his obligation to determine actual field dimensions and conditions that may affect his work. Regardless of any items overlooked by the submittal review, the requirements of the contract drawings and specifications must be followed and are not waived or superseded in any way by the review.

By description, catalog number, and manufacturer's names, standards of quality have been established by the Architect and the Engineer for certain manufactured equipment items and

specialties that are to be furnished by this Division. Alternate products and equipment may be proposed for use only if specifically named in the specifications or if given written prior approval in published addenda. Design equipment is the equipment listed on the drawings or if not listed on the drawings is the equipment first named in the specifications.

If the Engineer is required to do additional design work to incorporate changes caused by submitting equipment or products, different than the design equipment specified, as defined above, the contractor shall reimburse the engineer for additional time and expenses at the engineer's current, recognized, hourly rates.

## 1.7 DRAWINGS AND MEASUREMENTS

- A. Construction Drawings: The contract document drawings show the general design, arrangements, and extent of the system. In certain cases, the drawings may include details that show more nearly exact locations and arrangements; however, the locations, as shown diagrammatically, are to be regarded as general.

It shall be the work of this Section to make such slight alterations as may be necessary to make adjustable parts fit to fixed parts, leaving all complete and in proper shape when done. All dimensions given on the drawings shall be verified as related to this work and with the Architect's office before work is started.

This Section shall carefully study building sections, space, clearances, etc., and then provide offsets in piping or ductwork as required to accommodate the building structure without additional cost to the Owner. In any case and at any time during the construction process, a change in location required by obstacles or the installation of other trades not shown on the mechanical plans shall be made without charge.

The drawings shall not be scaled for roughing in measurements nor shall they be used as shop drawings. Where drawings are required for these purposes or where drawings must be made from field measurements, the Contractor shall take the necessary measurements and prepare the drawings. Shop drawings of the various subcontractors shall be coordinated to eliminate all interferences and to provide sufficient space for the installation of all equipment, piping, ductwork, etc.

The drawings and specifications have been prepared to supplement each other and they shall be interpreted as an integral unit with items shown on one and not the other being furnished and installed as though shown and called out on both.

- B. Coordination Drawings: The contractor shall provide coordination drawings for mechanical rooms, fan rooms, equipment rooms, and congested areas to eliminate conflicts with equipment, piping, or work of other trades. The drawings shall be a minimum scale of 1/4 inch= 1 foot and of such detail as may be required by the Engineer to fully illustrate the work. These drawings shall include all piping, conduit, valves, equipment, and ductwork.

Sheet-metal shop drawings will be required for all ductwork in the entire building. These drawings will show all ductwork in the entire building and shall be coordinated with architectural, structural and electrical portions of the project. The contractor shall specifically



obtain copies of the structural shop drawings and shall coordinate the ductwork shop drawings with approved structural members. These drawings shall be submitted to the engineer for review prior to any fabrication. The contractor is responsible for all modifications necessary to accommodate duct installation within the structural, architectural and electrical restrictions. These drawings, once reviewed by the engineer, will be made available to all mechanical, electrical, and fire sprinkler subcontractors to coordinate installation of their work.

#### 1.8 CONTRACTOR'S USE OF BUILDING EQUIPMENT

- A. The Contractor may use equipment such as electric motors, fans, heat exchangers, filters, etc., with the written permission of the Owner. As each piece of equipment is used (such as electric motors and fans), maintenance procedures approved by the manufacturer are to be followed. A careful record is to be kept of the length of the time the equipment is used, maintenance procedures followed, and any difficulty encountered. The record is to be submitted to the Owner upon acceptance. All fan belts and filter media (such as bearings) shall be carefully inspected just prior to acceptance. Any excessive wear noted shall require replacement. New filter media shall be installed in air handlers at the time systems are turned over to the owner.

#### 1.9 EXISTING CONDITIONS

- A. The Contractor shall carefully examine all existing conditions that might affect the mechanical system and shall compare these conditions with all drawings and specifications for work included under this contract. He shall, at such time, ascertain and check all conditions that may affect his work. No allowance shall subsequently be made in his behalf for an extra expense incurred as a result of his failure or neglect to make such examination. This Contractor shall include in his bid proposal all necessary allowances to repair or replace any item that will remain or will be removed, and any item that will be damaged or destroyed by new construction.
- B. The Contractor shall remove all abandoned piping, etc., required by new construction and cap or plug openings. No capping, etc., shall be exposed in occupied areas. All openings of items removed shall be sealed to match adjacent surfaces.
- C. The Contractor shall verify the exact location of all existing services, utilities, piping, etc., and make connections to existing systems as required or as shown on the drawings. The exact location of each utility line, together with size and elevation, shall be established before any on-site lines are installed. Should elevation or size of existing main utility lines make connections to them impossible as shown on drawings, then notification of such shall immediately be given to the Owners Representative for a decision.

#### 1.10 EQUIPMENT CAPACITIES

- A. Capacities shown for equipment in the specifications and on the drawings are the minimum acceptable. No equipment shall be considered as an alternate that has capacities or performance less than that of design equipment.
- B. All equipment shall give the specified capacity and performance at the job-site elevation. Manufacturers' standard ratings shall be adjusted accordingly. All capacities and performances

listed on drawings or in specifications are for job-site conditions.

#### 1.11 SEISMIC REQUIREMENTS FOR EQUIPMENT

- A. All equipment shall be furnished structurally adequate to withstand seismic forces as outlined in the International Building Code. Refer to section Mechanical Vibration Controls and Seismic Restraints. Equipment bases shall be designed for direct attachment of seismic snubbers and/or seismic anchors.

#### 1.12 COOPERATION WITH OTHER TRADES

- A. The Contractor shall refer to other drawings and parts of this specification that cover work of other trades that is carried on in conjunction with the mechanical work such that all work can proceed without interference resulting from lack of coordination.
- B. The Contractor shall properly size and locate all openings, chases, sleeves, equipment bases, and accesses. He shall provide accurate wiring diagrams to the Electrical Contractor for all equipment furnished under this Division.
- C. The ceiling cavity must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing, waste, and soil lines; supply, return, and exhaust ductwork; water piping; medical gases; fire protection piping; and pneumatic control piping.
- D. The mechanical Contractor shall insure that the installation of all piping, ducts and equipment is in compliance with Articles 110-16 and 384-4 of the National Electrical Code relative to proper clearances in front of and over all electrical panels and equipment. No piping or ductwork will be allowed to run over electrical panel.

#### 1.13 RESPONSIBILITY OF CONTRACTOR

- A. The Contractor is responsible for the installation of a satisfactory piece of work in accordance with the true intent of the drawings and specifications. He shall provide, as a part of his work and without expense, all incidental items required even though these items are not particularly specified or indicated. The installation shall be made so that its several component parts will function together as a workable system and shall be left with all equipment properly adjusted and in working order. The Contractor shall familiarize the Owner's Representative with maintenance and lubrication instructions as prepared by the Contractor and shall explain and fully instruct him relative to operating, servicing, and maintenance of them.

A. If a conflict arises between the drawings and the specifications the most stringent procedure/action shall be followed. A clarification to the engineer will help to determine the course of action to be taken. If a conflict arises between specification sections the engineer will determine which course of action is to be followed.

1.14 PIPE AND DUCT OPENINGS AND EQUIPMENT RECESSES

- A. Pipe and duct chases, openings, and equipment recesses shall be provided by others only if shown on architectural or structural drawings. All openings for the mechanical work, except where plans and specifications indicate otherwise, shall be provided as work of this Division. Include openings information with coordination drawings.
- B. Whether chases, recesses, and openings are provided as work of this Division or by others, this Contractor shall supervise their construction and be responsible for the correct size and location even though detailed and dimensioned on the drawings. This Contractor shall pay for all necessary cutting, repairing, and finishing if any are left out or incorrectly made. All necessary openings thru existing walls, ceilings, floors, roofs, etc. shall be provided by this Contractor unless indicated otherwise by the drawing and/or specifications.

1.15 UNFIT OR DAMAGED WORK

- A. Any part of this installation that fails, is unfit, or becomes damaged during construction, shall be replaced or otherwise made good. The cost of such remedy shall be the responsibility of this Division.

1.16 WORKMANSHIP

- A. Workmanship shall be the best quality of its kind for the respective industries, trades, crafts, and practices, and shall be acceptable in every respect to the Owner's representative. Nothing contained herein shall relieve the Contractor from making good and perfect work in all details in construction.

1.17 SAFETY REGULATION

- A. The Contractor shall comply with all local, Federal, and OSHA safety requirements in performance with this work. (See General Conditions). This Contractor shall be required to provide equipment, supervision, construction, procedures, and all other necessary items to assure safety to life and property.

1.18 ELECTRICAL SERVICES

- A. All equipment control wiring and all automatic temperature control wiring including all necessary contacts, relays, and interlocks, whether low or line voltage, except power wiring, shall be furnished and installed as work of this Division unless shown to be furnished by Division 26. All such wiring shall be in conduit as required by electrical codes. Wiring in the mechanical rooms, fans rooms and inaccessible ceilings and walls shall be installed in conduit as well. Installation of any and all wiring done under Division 21, 22 and 23 shall be in accordance with the requirements of Division 26, Electrical.

All equipment that requires an electrical connection shall be furnished so that it will operate

properly and deliver full capacity on the electrical service available.

Refer to the electrical control equipment and wiring shown on the diagrams. Any changes or additions required by specific equipment furnished shall be the complete responsibility of the Contractor furnishing the equipment.

The Mechanical Contractor must coordinate with the Electrical Contractor to insure that all required components of control work are included and fully understood. No additional cost shall accrue to the Owner as a result of lack of such coordination.

#### 1.19 WORK, MATERIALS, AND QUALITY OF EQUIPMENT

- A. Unless otherwise specified, all materials shall be new and of the best quality of their respective kinds and all labor shall be done in a most thorough and workmanlike manner.
- B. Products or equipment of any of the manufacturers cited herein or any of the products approved by the Addenda may be used. However, where lists of products are cited herein, the one first listed in the design equipment used in drawings and schedules to establish size, quality, function, and capacity standards. If other than design equipment is used, it shall be carefully checked for access to equipment, electrical and control requirements, valving, and piping. Should changes or additions occur in piping, valving, electrical work, etc., or if the work of other Contractors would be revised by the alternate equipment, the cost of all changes shall be borne as work of this Division.

The Execution portions of the specifications specify what products and materials may be used. Any products listed in the Product section of the specification that are not listed in the Execution portion of the specification may not be used without written approval by the Engineer.

- C. The access to equipment shown on the drawings is the minimum acceptable space requirements. No equipment that reduces or restricts accessibility to this or any other equipment will be considered.
- D. All major items of equipment are specified in the equipment schedules on the drawings or in these specifications and shall be furnished complete with all accessories normally supplied with the catalog item listed and all other accessories necessary for a complete and satisfactory installation.
- E. All welders shall be certified in accordance with Section IX of the ASME Boiler and Pressure Vessel Code, latest Edition.

#### 1.20 PROTECTION AGAINST WEATHER AND STORING OF MATERIALS

- A. All equipment and materials shall be properly stored and protected against moisture, dust, and wind. Coverings or other protection shall be used on all items that may be damaged or rusted or may have performance impaired by adverse weather or moisture conditions. Damage or defect developing before acceptance of the work shall be made good at the Contractor's expense.

- B. All open duct and pipe openings shall be adequately covered at all times.

1.21 INSTALLATION CHECK

- A. An experienced, competent, and authorized representative of the manufacturer or supplier of each item of equipment indicated in the equipment schedule and the seismic supplier shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment supplier's representative shall be present when the equipment is placed in operation. The equipment supplier's representative shall revisit the job site as often as necessary until all trouble is corrected and the equipment installation and operation is satisfactory to the Engineer.
- B. Each equipment supplier's representative shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and, (4) has been operated under full load conditions and that it operated satisfactorily.
- C. All costs for this work shall be included in the prices quoted by equipment suppliers.

1.22 EQUIPMENT LUBRICATION

- A. The Contractor shall properly lubricate all pieces of equipment before turning the building over to the Owner. A linen tag shall be attached to each piece of equipment, showing the date of lubrication and the lubricant used. No equipment shall be started until it is properly lubricated.
- B. Necessary time shall be spent with the Owner's Representative to thoroughly familiarize him with all necessary lubrications and maintenance that will be required of him.
- C. Detergent oil as used for automotive purposes shall not be used for this work.

1.23 CUTTING AND PATCHING

- A. No cutting or drilling in structural members shall be done without written approval of the Architect. The work shall be carefully laid out in advance, and cutting, channeling, chasing, or drilling of floors, walls, partitions, ceilings, or other surfaces necessary for the mechanical work shall be carefully done. Any damage to building, piping, or equipment shall be repaired by professional plasterers, masons, concrete workers, etc., and all such work shall be paid for as work of this Division.
- B. When concrete, grading, etc., is disturbed, it shall be restored to original condition as described in the applicable Division of this Specification.

1.24 EXCAVATION AND BACKFILLING

- A. All necessary excavations and backfilling for the Mechanical phase of this project shall be provided as work of this Division. Trenches for all underground pipelines shall be excavated to the required depths. The bottom of trenches shall be compacted hard and graded to obtain

required fall. Backfill shall be placed in horizontal layers, not exceeding 12 inches in thickness, and properly moistened. Each layer shall be compacted, by suitable equipment, to a density of not less than 95 percent as determined by ASTM D-1557. After pipelines have been tested, inspected, and approved, the trench shall be backfilled with selected material. Excess earth shall be hauled from the job site. Fill materials approved by the Architect shall be provided as work of this Division.

- B. No trenches shall be cut near or under any footings without consultation first with the Architect's office. Any trenches or excavations more than 30 inches deep shall be tapered, shored, covered, or otherwise made absolutely safe so that no vehicle or persons can be injured by falling into such excavations, or in any way be harmed by cave-ins, shifting earth, rolling rocks, or by drowning. This protection shall be extended to all persons approaching excavation related to this work whether or not such persons are authorized to be in the vicinity of the construction.

#### 1.25 ACCESS

- A. Provide access doors in walls, ceilings and floors by this division unless otherwise noted. For access to mechanical equipment such as valves, dampers, VAV boxes, fans, controls, etc. Refer to Division 8 for door specifications. All access doors shall be 24" x 24" unless otherwise indicated or required. Coordinate location of doors with the Architect prior to installation. . If doors are not specified in Division 8, provide the following: Doors in ceilings and wall shall be equal to JR Smith No. 4760 bonderized and painted. Doors in tile walls shall be equal to JR Smith No. 4730 chrome plated. Doors in floors shall be equal to JR Smith No. 4910
- B. Valves: Valve must be installed in locations where access is readily available. If access is compromised, as judged by the Mechanical Engineer, these valves shall be relocated where directed at the Contractors expense.
- C. Equipment: Equipment must be installed in locations and orientations so that access to all components requiring service or maintenance will not be compromised. If access is compromised, as judged by the Mechanical Engineer, the contractor shall modify the installation as directed by the Engineer at the Contractors expense.
- D. It is the responsibility of this division to install terminal boxes, valves and all other equipment and devices so they can be accessed. If any equipment or devices are installed so they cannot be accessed on a ladder a catwalk and ladder system shall be installed above the ceiling to access and service this equipment.

#### 1.26 CONCRETE BASES AND INSERTS

- A. Bases: The concrete bases shall be provided and installed as work by this division. This Division shall be responsible for the proper size and location of bases and shall furnish all required anchor bolts and sleeves with templates to be installed as work of Division 3, Concrete.

All floor-mounted mechanical equipment shall be set on 6-inch high concrete bases, unless otherwise noted or shown on drawings. Such bases shall extend 6 inches beyond equipment or mounting rails on all sides or as shown on the drawings and shall have a 1-inch beveled edge all

around.

- B. Inserts: Where slotted or other types of inserts required for this work are to be cast into concrete, they shall be furnished as work of this Division

Concrete inserts and pipe support systems shall be equal to Unistrut P3200 series for all piping where more than one pipe is suspended at a common location. Spacing of the inserts shall match the size and type of pipe and of ductwork being supported. The Unistrut insert and pipe support system shall include all inserts, vertical supports, horizontal support members, clamps, hangers, rollers, bolts, nuts, and any other accessory items for a complete pipe-supporting system.

#### 1.27 CLEANING AND PAINTING

- A. Cleaning: After all tests and adjustments have been made and all systems pronounced satisfactory for permanent operation, this Contractor shall clean all exposed piping, ductwork, insulated members, fixture, and equipment installed under this Section and leave them ready for painting. He shall refinish any damaged finish and leave everything in proper working order. The Contractor shall remove all stains or grease marks on walls, floors, glass, hardware, fixtures, or elsewhere, caused by his workman or for which he is responsible. He shall remove all stickers on plumbing fixtures, do all required patching up and repair all work of others damaged by this division of the work, and leave the premises in a clean and orderly condition.

- B. Painting: Painting of exposed pipe, insulated pipe, ducts, or equipment is work of Division 9, Painting.

Mechanical Contractor: All equipment which is to be furnished in factory prefinished conditions by the mechanical Contractor shall be left without mark, scratch, or impairment to finish upon completion of job. Any necessary refinishing to match original shall be done. Do not paint over nameplates, serial numbers, or other identifying marks.

- C. Removal of Debris, Etc: Upon completion of this division of the work, remove all surplus material and rubbish resulting from this work, and leave the premises in a clean and orderly condition.

#### 1.28 CONTRACT COMPLETION

- A. Incomplete and Unacceptable Work: If additional site visits or design work is required by the Engineer or Architect because of the use of incomplete or unacceptable work by the Contractor, then the Contractor shall reimburse the Engineer and Architect for all additional time and expenses involved.
- B. Maintenance Instructions: The Contractor shall furnish the Owner complete printed and illustrated operating and maintenance instructions covering all units of mechanical equipment, together with parts lists.
- C. Instructions To Owner's Representatives: In addition to any detailed instructions called for, the mechanical Contractor must provide, without expense to the Owner, competent instructors to

train the Owner's representatives who will be in charge of the apparatus and equipment, in the care, adjustment, and operation of all parts on the heating, air conditioning, ventilating, plumbing, fire protection, and automatic temperature control equipment. Instruction dates shall be scheduled at time of final inspection. A written report specifying times, dates, and name of personnel instructed shall be forwarded to the Architect. A minimum of four 8-hour instruction periods shall be provided. The instruction periods will be broken down to shorter periods when requested by the Owner. The total instruction hours shall not be reduced. The ATC Contractor shall provide 4 hours of instructions. The remaining hours shall be divided between the mechanical and sheet metal Contractor.

- D. Guarantee: By the acceptance of any contract award for the work herein described or shown on the drawings, the Contractor assumes the full responsibility imposed by the guarantee as set forth herein and in the General Conditions, and should protect himself through proper guarantees from equipment and special equipment Contractors and from subcontractors as their interests may appear.

The guarantee so assumed by the Contractor and as work of this Section is as follows:

That the entire mechanical system, including plumbing, heating, and air-conditioning system shall be quiet in operation.

That the circulation of water shall be complete and even.

That all pipes, conduit, and connections shall be perfectly free from foreign matter and pockets and that all other obstructions to the free passage of air, water, liquid, sewage, and vent shall be removed.

That he shall make promptly and free of charge, upon notice from the Owner, any necessary repairs due to defective workmanship or materials that may occur during a period of one year from date of Substantial Completion.

That all specialties, mechanical, and patent devices incorporated in these systems shall be adjusted in a manner that each shall develop its maximum efficiency in the operation of the system; i.e., diffusers shall deliver the designed amount of air shown on drawings, thermostats shall operate to the specified limits, etc.

All equipment and the complete mechanical, ductwork, piping and plumbing systems shall be guaranteed for a period of one year from the date of the Architect's Certificate of Substantial Completion, this includes all mechanical, ductwork, piping and plumbing equipment and products and is not limited to boiler, chillers, coils, fans, filters etc. Any equipment supplier not willing to comply with this guarantee period shall not submit a bid price for this project. The Contractor shall be responsible for a 100-percent guarantee for the system and all items of equipment for this period. If the contractor needs to provide temporary heating or cooling to the building and or needs to insure systems are installed properly and or to meet the project schedule the guaranteed of all systems and equipment shall be as indicated above, on year from the date of the Architect's Certificate of Substantial Completion.

All filters used during construction shall be replaced just before equipment is turned over to the Owner, and all required equipment and parts shall be oiled. Any worn parts shall also be



replaced.

If any systems or equipment is used for temporary heating or cooling the systems shall be protected so they remain clean. I.e. if the ductwork systems are used temporary filters and a filter holder (not duct-taped to ducts or grilles) shall be installed to insure the systems and the equipment remain clean.

#### 1.29 CURBS

- A. Unless otherwise noted in these specifications or on the documents all roof curbs for all equipment are to be provided by division 22 and 23.

#### 1.30 TEST RUN

- A. The Mechanical Contractor shall operate the mechanical system for a minimum of 30 days to prove the operation of the system.

#### 1.31 EQUIPMENT STARTUP AND CHECKOUT:

- A. Each major piece of equipment shall be started and checked out by an authorized representative of the equipment manufacturer. A certificate indicating the equipment is operating to the satisfaction of the manufacturer shall be provided and shall be included in the commissioning report.
- B. This contractor shall coordinate commissioning procedures and activities with the commissioning agent.

#### 1.32 DEMOLITION

This project shall include the demolition of all pneumatic ATC controls, including all piping, tubing, actuators, panels and other components, unless noted otherwise in the drawings. The existing ATC compressor shall be relocated and reused for compressed air outlets in the shop and science areas. Boiler controls shall remain in service and are NOT in the scope of the demolition work.

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

Proceed with demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools

or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.

Maintain adequate ventilation when using cutting torches.

Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.

Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

Dispose of demolished items and materials promptly.

Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

Existing Facilities: Comply with building manager's requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

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

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

Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

END OF SECTION 23 0100

## SECTION 23 0500 - COMMON WORK RESULTS FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes 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.
12. Link-Seal

#### 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, crawlspace, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- 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:
- G. The following are industry abbreviations for rubber materials:
  - 1. EPDM: Ethylene-propylene-diene terpolymer rubber.
  - 2. NBR: Acrylonitrile-butadiene rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For the following:
  - 1. Transition fittings.
  - 2. Dielectric fittings.
  - 3. Mechanical sleeve seals.
  - 4. Escutcheons.
- B. Welding certificates.

#### 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.

#### 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."

### 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 (3.2-mm) 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 (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAgl, silver alloy for refrigerant piping, unless otherwise indicated.
- F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 TRANSITION FITTINGS

- 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.

## 2.5 DIELECTR DIELECTRIC FITTINGS

- A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
- E. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
- F. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
  1. Provide separate companion flanges and steel bolts and nuts for 150- or 300-psig minimum working pressure as 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.
- 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. Capitol Manufacturing Co.
    - b. Central Plastics Company.
    - c. Watts Industries, Inc.; Water Products Div

## 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: Stainless steel. Include two for each sealing element.
  - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

## 2.7 SLEEVES

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

## 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 and rough brass.
- D. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- E. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

## 2.9 GROUT

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

## 2.10 LINK-SEAL MODULAR SEAL PRESSURE PLATES

- A. Link-Seal® modular seal pressure plates shall be molded of glass reinforced Nylon Polymer with the following properties:
  - 1. Izod Impact - Notched = 2.05ft-lb/in. per ASTM D-256
  - 2. Flexural Strength @ Yield = 30,750 psi per ASTM D-790
  - 3. Flexural Modulus = 1,124,000 psi per ASTM D-790
  - 4. Elongation Break = 11.07% per ASTM D-638
  - 5. Specific Gravity = 1.38 per ASTM D-792
- B. Models LS200-275-300-315 shall incorporate the most current Link-Seal® Modular Seal design modifications and shall include an integrally molded compression assist boss on the top (bolt entry side) of the pressure plate, which permits increased compressive loading of the rubber sealing element. Models 315-325-340-360-400-410-425-475-500-525-575-600 shall incorporate an integral recess known as a "Hex Nut Interlock" designed to accommodate commercially available fasteners to insure proper thread engagement for the class and service of metal hardware. All pressure plates shall have a permanent identification of the manufacturer's name molded into it.
- C. For fire service, pressure plates shall be steel with 2-part Zinc Dichromate Coating.

- D. Link-Seal® Modular Seal Hardware: All fasteners shall be sized according to latest Link-Seal® modular seal technical data. Bolts, flange hex nuts shall be:

1. 316 Stainless Steel per ASTM F593-95, with a 85,000 psi average tensile strength.

## 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: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- N. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
- 1. Cut sleeves to length for mounting flush with both surfaces.
    - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches 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.
  - O. 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.
  - P. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
    1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
  - Q. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.
  - R. Verify final equipment locations for roughing-in.
  - S. 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 B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 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.

### 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 and according to seismic codes at Project.
  - 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.

### 3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 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 GROUTING

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

### 3.9 LINK SEAL

- A. Provide Link Seal at all piping penetrations from the outside.

END OF SECTION 23 0500

## SECTION 23 0519 - METERS AND GAGES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Thermometers.
  - 2. Gages.
  - 3. Test plugs.
  - 4. Flowmeters.

#### 1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

#### 1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.

### PART 2 - PRODUCTS

#### 2.1 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, are limited to, the following:
  - 1. Palmer - Wahl Instruments Inc.
  - 2. Trerice, H. O. Co.
  - 3. Weiss Instruments, Inc.
  - 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 9 inches long.
- C. Tube: Red or blue reading, organic-liquid filled, with magnifying lens.



- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

## 2.2 THERMOWELLS

- A. Manufacturers: Subject to compliance with requirements, are limited to, the following:
  - 1. AMETEK, Inc.; U.S. Gauge Div.
  - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  - 3. Ernst Gage Co.
  - 4. Marsh Bellofram.
  - 5. Miljoco Corp.
  - 6. NANMAC Corporation.
  - 7. Noshok, Inc.
  - 8. Palmer - Wahl Instruments Inc.
  - 9. REO TEMP Instrument Corporation.
  - 10. Tel-Tru Manufacturing Company.
  - 11. Terice, H. O. Co.
  - 12. Weiss Instruments, Inc.
  - 13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
  - 14. WIKA Instrument Corporation.
  - 15. Winters Instruments.
- B. Manufacturers: Same as manufacturer of thermometer being used.
- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

## 2.3 PRESSURE GAGES

- A. Manufacturers: Subject to compliance with requirements, are limited to, the following:
  - 1. AMETEK, Inc.; U.S. Gauge Div.
  - 2. Ashcroft Commercial Instrument Operations; Dresser Industries; Instrument Div.
  - 3. Ernst Gage Co.
  - 4. Eugene Ernst Products Co.
  - 5. KOBOLD Instruments, Inc.

6. Marsh Bellofram.
7. Miljoco Corp.
8. Noshok, Inc.
9. Palmer - Wahl Instruments Inc.
10. REO TEMP Instrument Corporation.
11. Trerice, H. O. Co.
12. Weiss Instruments, Inc.
13. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
14. WIKA Instrument Corporation.
15. Winters Instruments.

B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Liquid-filled type, drawn steel or cast aluminum, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass.
8. Ring: Stainless steel.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
11. Range for Fluids under Pressure: Two times operating pressure.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass or stainless-steel needle type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

## 2.4 TEST PLUGS

A. Manufacturers: Subject to compliance with requirements, [are limited to, the following:

1. Flow Design, Inc.
2. MG Piping Products Co.
3. National Meter, Inc.
4. Peterson Equipment Co., Inc.
5. Sisco Manufacturing Co.
6. Trerice, H. O. Co.
7. Twin City Hose.
8. Watts Industries, Inc.; Water Products Div.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.

- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- D. Core Inserts: One or two self-sealing rubber valves.
  - 1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
  - 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.
- E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, one thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
  - 1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
  - 2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
  - 3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
  - 4. Carrying case shall have formed instrument padding.

## 2.5 WAFER-ORIFICE FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, are limited to, the following:
  - 1. ABB, Inc.; ABB Instrumentation.
  - 2. Armstrong Pumps, Inc.
  - 3. Badger Meter, Inc.; Industrial Div.
  - 4. Bell & Gossett; ITT Industries.
  - 5. Meriam Instruments Div.; Scott Fetzer Co.
- B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
- D. Pressure Rating: 300 psig.
- E. Temperature Rating: 250 deg F.
- F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
  - 1. Scale: Gallons per minute.
  - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.

- H. Operating Instructions: Include complete instructions with each flowmeter.

## 2.6 VENTURI FLOWMETERS

- A. Manufacturers: Subject to compliance with requirements, are limited to, the following
  - 1. Armstrong Pumps, Inc.
  - 2. Badger Meter, Inc.; Industrial Div.
  - 3. Bailey-Fischer & Porter Co.
  - 4. Flow Design, Inc.
  - 5. Gerand Engineering Co.
  - 6. Hyspan Precision Products, Inc.
  - 7. Leeds & Northrup.
  - 8. McCrometer, Inc.
  - 9. Preso Meters Corporation.
  - 10. Victaulic Co. of America.
- B. Description: Differential-pressure design for installation in piping; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Bronze, brass, or factory-primed steel; with brass fittings and attached tag with flow conversion data.
- D. Pressure Rating: 250 psig.
- E. Temperature Rating: 250 deg F.
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged or welded.
- H. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- I. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having 6-inch- diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
  - 1. Scale: Gallons per minute.
  - 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- J. Operating Instructions: Include complete instructions with each flowmeter.

## PART 3 - EXECUTION

### 3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
  - 1. Inlet and outlet of each hydronic zone.
  - 2. Inlet and outlet of each hydronic boiler, chiller and cooling tower.
  - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
  - 4. Inlet and outlet of each hydronic heat exchanger.
- B. Provide the following temperature ranges for thermometers:
  - 1. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
  - 2. Condenser Water: 0 to 160 deg F, with 2-degree scale divisions.
  - 3. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions.
  - 4. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.

### 3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at chilled- and condenser-water inlets and outlets of chillers.
- C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

### 3.3 INSTALLATIONS

- A. Install thermowells with socket extending one-third of diameter of pipe and in vertical position in piping tees where thermometers are indicated.
- B. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- C. Install test plugs in tees in piping.
- D. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- E. Install permanent indicators on walls or brackets in accessible and readable positions.
- F. Install connection fittings for attachment to portable indicators in accessible locations.
- G. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- H. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

END OF SECTION 23 0519

## SECTION 23 0529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Metal pipe hangers and supports.
  - 2. Trapeze pipe hangers.
  - 3. Metal framing systems.

#### 1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

#### 1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to **ASCE/SEI 7**.
  - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

## 1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: **Signed and sealed by a qualified professional engineer.** Show fabrication and installation details and include calculations for the following; include Product Data for components:
  1. Trapeze pipe hangers.
  2. Metal framing systems.

## 1.6 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

## PART 2 - PRODUCTS

### 2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
  1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
  2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
  3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
  4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
  5. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.

### 2.2 TRAPEZE PIPE HANGERS

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

### 2.3 METAL FRAMING SYSTEMS



A. MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International.
  - b. Cooper B-Line, Inc.; a division of Cooper Industries.
  - c. ERICO/Michigan Hanger Co. ; ERISTRUT Div.
  - d. FNW/Ferguson Enterprises
  - e. GS Metals Corp.
  - f. Hilti, Inc.insert manufacturer's name.
  - g. Power-Strut Div. Tyco International.
  - h. Thomas & Betts Corporation.
  - i. Tolco Inc.
  - j. Unistrut; an Atkore International company.
2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with intumed lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.
7. Metallic Coating:
  - a. **Electroplated zinc.**

B. Non-MFMA Manufacturer Metal Framing Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Anvil International; a subsidiary of Mueller Water Products, Inc.
  - b. Empire Industries, Inc.
  - c. ERICO International Corporation.
  - d. FNW/Ferguson Enterprises
  - e. Haydon Corporation.
  - f. NIBCO INC.
  - g. PHD Manufacturing, Inc.
  - h. PHS Industries, Inc.
2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
3. Standard: Comply with MFMA-4.
4. Channels: Continuous slotted steel channel with intumed lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of **carbon steel**.

7. Coating:
  - a. **Zinc.**

## 2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  1. Carpenter & Paterson, Inc.
  2. Clement Support Services.
  3. ERICO International Corporation.
  4. National Pipe Hanger Corporation.
  5. PHS Industries, Inc.
  6. Pipe Shields Inc.
  7. Piping Technology & Products, Inc.
  8. Rilco Manufacturing Co., Inc.
  9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping:
  1. **Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig** minimum compressive strength.
- C. Insulation-Insert Material for Hot Piping:
  1. **Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig** minimum compressive strength.
- D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

- E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

## 2.5 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
  - 1. Properties: Nonstaining, noncorrosive, and nongaseous.
  - 2. Design Mix: **5000-psi**, 28-day compressive strength.

## PART 3 - EXECUTION

### 3.1 HANGER AND SUPPORT INSTALLATION

- A. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- B. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- C. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
  - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
  - 2. Field fabricate from ASTM A 36, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

- E. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- F. 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.
- G. Install lateral bracing with pipe hangers and supports to prevent swaying.
- H. 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.
- I. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- J. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- K. Insulated Piping:
  - 1. Attach clamps and spacers to piping.
    - a. Piping Operating **above** Ambient Air Temperature: Clamp may project through insulation.
    - b. Piping Operating **below** Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
  - 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
  - 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
    - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:
  - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
  - b. NPS 4: 12 inches long and 0.06 inch thick.
  - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
  - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
  - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
5. Pipes NPS 8 and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

### 3.2 METAL FABRICATIONS

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

### 3.3 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**.

### 3.4 PAINTING

- A. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in **Division 09**.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

### 3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel **pipe hangers and supports** and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
  - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30**.
  - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes **NPS 4 to NPS 24**, requiring up to **4 inches** of insulation.
  - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes **NPS 3/4 to NPS 36**, requiring clamp flexibility and up to **4 inches** of insulation.
  - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes **NPS 1/2 to NPS 24** if little or no insulation is required.
  - 5. Pipe Hangers (MSS Type 5): For suspension of pipes **NPS 1/2 to NPS 4**, to allow off-center closure for hanger installation before pipe erection.
  - 6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes **NPS 3/4 to NPS 8**.

7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
  8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
  9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes **NPS 1/2 to NPS 8**.
  10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 8**.
  11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes **NPS 3/8 to NPS 3**.
  12. U-Bolts (MSS Type 24): For support of heavy pipes **NPS 1/2 to NPS 30**.
  13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
  14. Pipe Saddle Supports (MSS Type 36): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
  15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
  16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes **NPS 2-1/2 to NPS 36** if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
  17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes **NPS 1 to NPS 30**, from two rods if longitudinal movement caused by expansion and contraction might occur.
  18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes **NPS 2-1/2 to NPS 24**, from single rod if horizontal movement caused by expansion and contraction might occur.
  19. Complete Pipe Rolls (MSS Type 44): For support of pipes **NPS 2 to NPS 42** if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
  20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes **NPS 2 to NPS 24** if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
  21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes **NPS 2 to NPS 30** if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24**.
  2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers **NPS 3/4 to NPS 24** if longer ends are required for riser clamps.
- J. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
  2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
  3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
  4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
  5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.
- K. 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.
- L. 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.
- M. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
  2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed **1-1/4 inches**.
  3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
  4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
  5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from hanger.
  6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from base support.
  7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to **25 percent** to allow expansion and contraction of piping system from trapeze support.
  8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
    - a. Horizontal (MSS Type 54): Mounted horizontally.
    - b. Vertical (MSS Type 55): Mounted vertically.
    - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- N. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- O. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- P. Use **powder-actuated fasteners** instead of building attachments where required in concrete construction.

END OF SECTION 23 0529

## SECTION 23 0548 - SEISMIC RESTRAINT AND VIBRATION ISOLATION

All isolation materials, flexible connectors and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

### PART 1 - SEISMIC DESIGN

#### 1.1 DESCRIPTION

The work in this section consists of furnishing engineering and materials necessary for the required seismic design of supports and attachments for systems and equipment contained herein for the project.

Other sections of DIVISION 21, 22 & 23 form a part of this section. Refer to all sections for a complete description of the work.

Unless otherwise specified, all mechanical, electrical, fire protection and plumbing equipment, pipe, and duct shall be restrained to resist seismic forces. Restraints shall maintain equipment, piping, and duct work in a captive position.

The 2015 IBC/ASCE 7-05 requires that mechanical & electrical components be assigned a component importance factor. This importance factor is used to determine which equipment may or may not be exempt from seismic design force requirements. The component importance factor is determined as follows:

$I_p = 1.5$	Life-safety component is required to function after an earthquake.
$I_p = 1.5$	Component contains hazardous or flammable material.
$I_p = 1.5$	Storage racks in occupancies open to the general public (e.g., warehouse retail stores).
$I_p = 1.0$	All other components.

In addition, for structures in Occupancy Category IV (Buildings having essential facility required for post earthquake recovery, and those containing substantial quantities of hazardous substances as designated by local building officials),

$I_p = 1.5$	For components needed for continued operation of the facility or whose failure could impair the continued operation of the facility.
-------------	--

SEE PROJECT DOCUMENTS FOR COMPONENT AND SYSTEM  $I_p$ 's

## 1.2 GENERAL SEISMIC DESIGN REQUIREMENTS:

Per IBC 1613.1, the seismic restraint of nonstructural components shall meet the requirements of ASCE 7. If the component in question is exempted by Section 13.1.4 of ASCE 7, a submittal noting that seismic restraint of that particular component is not required.

The seismic restraint design must meet the requirements listed in Table 13.2-1 of ASCE 7. These requirements may be met by providing a project-specific design prepared by a registered design professional in the state where the project is being constructed, and a manufacturer's certification that the component is seismically qualified.

On projects with Seismic Design Category A or B, seismic design or restraint is not required.

On projects with Seismic Design Category C:

Components with  $I_p = 1.0$  do not require seismic design or restraint.

Duct: Where duct  $I_p > 1.0$ , brace all duct  $> 5 \text{ lb/lf}$

Pipe: Where pipe  $I_p > 1.0$ , brace all pipe  $> 2''$  diameter.

Equipment: Where equipment  $I_p > 1.0$ , provide anchorage or restraint design for all floor, wall mounted or suspended equipment.

On projects with Seismic Design Category D:

Seismic anchorage design is not required for floor mounted mechanical, electrical, and plumbing components where  $I_p = 1.0$  and flexible connections between the components and associated duct work, piping and conduit are provided, the components are mounted at 4 feet (1219 mm) or less above a floor level and they weigh 400 pounds (1780 N) or less.

Seismic anchorage or bracing is not required for hanging, wall mounted, and flexibly supported mechanical, plumbing and electrical components that weigh 20 pounds (89 N) or less, where  $I_p = 1.0$  and flexible connections are provided between the components and associated duct work, piping and conduit.

Where equipment  $I_p > 1.0$ , provide anchorage or restraint design for all floor, wall mounted or suspended equipment.

Duct: Where duct  $I_p = 1.0$ , brace all rectangular duct  $> 6 \text{ sqft}$ , all round duct  $> 33''$  diameter.

Where duct  $I_p > 1.0$ , brace all duct  $> 5 \text{ lb/lf}$

Pipe: Where pipe  $I_p = 1.0$ , brace all pipe  $> 3''$  diameter.

Where pipe  $I_p > 1.0$ , brace all pipe  $> 1''$  diameter.

Equipment items installed in-line and rigidly mounted at the inlet and outlet to the duct system (e.g, fans, heat exchangers and humidifiers) with an operating weight less than 75 pounds (334 N) need not be braced if the duct run it is attached to is braced. Equipment with an operating weight greater than 75 lbs must be braced and supported independent of the duct.

Regardless of Seismic Design Category:

Seismic restraints are not required on piping supported by individual clevis hangers where the distance, as measured from the top of the pipe to the supporting structure, is less than 12 inches (305mm) for the entire pipe run and the pipe can accommodate the expected deflections. Trapeze or double rod hangers, where the distance from the top of the trapeze or support to the structure is less than 12 inches for the entire run. HVAC ducts suspended from hangers that are 12 inches (305 mm) or less in length from the top of the duct to the supporting structure and the hangers are detailed to avoid significant bending of the hangers and their connections. Duct must be positively attached to hanger with minimum #10 screws within 2" from the top of the duct. Hanger rods shall not be constructed in a manner that would subject the rod to bending moments (swivel, eye bolt, or vibration isolation hanger connection to structure are required to prevent bending moments when utilizing this exclusion). Displacement of the component shall not cause damaging impact with other utilities or the structure. Flexible connections are required between unbraced systems and equipment to accommodate differential displacements. Where HVAC systems  $I_p > 1.0$ , this exclusion shall not apply (per ASCE 7, 13.6.7).

Brace spacing for low deformability piping and duct (e.g., cast iron, PVC, fiberglass, glass, etc.) shall not exceed one half of the brace spacing of high deformability piping or duct.

Wherever systems or components are vibration isolated, seismic restraints must be designed to prevent short circuiting of the isolation systems.

#### ANCHORAGE REQUIREMENTS:

All post installed anchors utilized in the seismic design must be qualified for use in cracked concrete and approved for use with seismic loads.

Expansion anchors shall not be used for anchorage of equipment with motors rated over 10hp with the exception of undercut expansion anchors. Spring or internally isolated equipment are exempt from this requirement.

All beam clamps utilized for vertical support must also incorporate retention straps.

All seismic brace arm anchorages to include concrete anchors, beam clamps, truss connections, etc., must be approved for use with seismic loads.

Calculations and restraint device submittal drawings shall specify anchor bolt type, embedment, concrete compressive strength, minimum spacing between anchors, and minimum distances of anchors from concrete edges. Concrete anchor locations shall not be near edges, stress joints, or an existing fracture. All bolts shall be ASTM A307 or better.

Gravity supports must be designed by a licensed engineer in the project state for systems subject to seismic requirements as listed above. Gravity supports include primary support and anchorage of all distributed systems, riser supports, and supports for floor mounted utilities. Design is to include seismic loads in conjunction with dead loads as required by the IBC/ASCE 7.

See Part 2 for additional seismic restraint requirements associated with vibration isolated systems and components.

### 1.3 MANUFACTURER'S RESPONSIBILITIES:

The following seismic restraint manufacturers are accepted: International Seismic Application Technology (ISAT), Amber / Booth, Mason Industries Inc. (M.I.), Kinetics Noise Control Inc. (K.N.C.), Vibration Mounting & Controls, Inc. (V.M.C.) and Vibro Acoustics.

Determine vibration isolation and seismic restraint sizes and locations.

Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.

Provide calculations to determine restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified by the manufacturers engineer licensed in the state of Utah

Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer. Copies of testing and calculations must be submitted as part of submittal documents. OSHPD pre-approved restraint systems are exempt from this requirement if their pre-approval is current and based upon the IBC 2015 (i.e. OPA-07 pre-approval numbers).

### 1.4 QUALITY CONTROL

All seismic restraint components exposed to the weather shall be zinc or cadmium-plated, epoxy coat or PVC coated, and/or galvanized steel. Nuts, bolts and washers may be zinc-electroplated. Restraints for outdoor mounted components shall provide adequate restraint for the greater of either wind or seismic loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.

Seismic restraint designer must provide, in writing, the special inspection requirements for all Designated Seismic Systems as indicated in Chapter 17 of the IBC.

### 1.5 SUBMITTALS

Each contractor responsible for the installation of Designated Seismic Systems (systems with component  $I_p > 1.0$ ) must submit a "Statement of Responsibility" as required by Section 1706.1 of the IBC 2015, prior to beginning work on the system or component.

Submittal documents must include a "Basis for Design" or "Design Criteria" which includes a statement from the registered design professional that the design complies with the requirements of the ASCE 7-05, Chapter 13 and IBC 2015 chapter 1912/ACI 318 (concrete anchors).

Submittals must include seismic bracing layout drawings indicating the location of all seismic restraints. The submittal package must include seismic restraint details providing specific information relating to the materials, type, size, and locations of anchorages; materials used for bracing; attachment requirements of bracing to structure and component; and locations of transverse and longitudinal sway bracing and rod stiffeners.

Catalog cut sheets and installation instructions shall be included for each type seismic restraint used on equipment or components being restrained.

Submit special inspection requirements as required under 1.4 at time of seismic submittals.

Submittal drawings and calculations must be stamped by a registered professional engineer in the State where the project is being constructed who is responsible for the seismic restraint design. All seismic restraint submittals not complying with this certification will be rejected.

## 1.6 SEISMIC CERTIFICATION OF EQUIPMENT

For equipment or components where  $I_p = 1.0$ .

Submittal documents must include a "Basis for Design" or "Design Criteria" which includes a statement from the registered design professional that the design complies with the requirements of the ASCE 7-05, Chapter 13 and IBC 2015 chapter 1912/ACI 318 (concrete anchors). In addition, the basis for compliance must also be noted, as listed below:

- Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
- Submittal of the manufacturer's certification that the equipment is seismically qualified by:
  - o An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
  - o Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
  - o Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.
- The equipment and components listed below are considered rugged and shall not require Special Seismic Certification:
  - o Valves (not in cast-iron housings, except for ductile cast iron).
  - o Pneumatic operators.
  - o Hydraulic operators.
  - o Motors and motor operators.
  - o Horizontal and vertical pumps (including vacuum pumps).
  - o Air compressors
  - o Refrigerators and freezers.
  - o Elevator cabs.
  - o Underground tanks.
  - o Equipment and components weighing not more than 20 lbs. supported directly on structures (and not mounted on other equipment or components) with supports and attachments in accordance with Chapter 13, ASCE 7-05.

Exemptions in this section are for factory assembled discrete equipment and components only and do not apply to site assembled or field assembled equipment or equipment anchorage. The list is based in part on OSHPD Code Application Notice 2-1708A.5.

Special Certification requirements for Designated Seismic Systems (i.e.  $I_p > 1.0$ ):

Seismic Certificates of Compliance supplied by manufacturers shall be submitted for all components that are part of Designated Seismic Systems. In accordance with the ASCE 7, certification shall be via one of the following methods:

For active mechanical and electrical equipment that must remain operable following the design earthquake:

- Testing as detailed by part c above.
- Experience data as detailed by part c above.
- Equipment that is considered “rugged” per part c above.

Components with hazardous contents shall be certified by the manufacturer as maintaining containment following the design earthquake by:

- Testing as detailed by part c above.
- Experience data as detailed by part c above.
- Engineering analysis utilizing dynamic characteristics and forces. Tanks (without vibration isolators) designed by a registered design professional in accordance with ASME Boiler and Pressure Vessel Code, 2004 (BPVC 2004), and satisfying the force and displacement requirements of Sections 13.3.1 and 13.3.2 of ASCE 7-05 having an importance factor,  $I = 1.5$  and reviewed by DFCM shall be considered to satisfy the Special Seismic Certification requirements on the basis of ASCE 7-05 Section 13.6.9.

## 1.7 INSTALLATION

Comply with manufacturer/engineer's instructions for the installation of seismic restraint materials and products.

## PART 2 - VIBRATION ISOLATION

See Part 1 for seismic design requirements. Additional seismic design requirements are outlined below where they pertain specifically to vibration isolated components or systems.

### 2.1 DESCRIPTION

The work in this section consists of furnishing engineering and materials necessary for vibration isolation for systems and equipment contained herein for the project.

Other sections of DIVISION 21, 22 & 23 form a part of this section. Refer to all sections for a complete description of the work.

All mechanical equipment .75 HP and over listed in the equipment schedule shall be mounted on vibration isolators to prevent the transmission of objectionable vibration and vibration induced sound to the building structure.

All isolation materials, flexible connectors and seismic restraints shall be of the same vendor and shall be selected and certified using published or factory certified data. Any variance or non-compliance with these specification requirements shall be corrected by the contractor in an approved manner.

The contractor and vendor of the isolation and seismic restraints for floor mounted equipment shall refer to the isolator and seismic restraint schedule which lists isolator types, isolator deflections and seismic restraint type. Vibration isolators shall be selected in accordance with the equipment, pipe or duct weight distribution so as to produce reasonably uniform deflections.

Install full line size flexible pipe connectors at the inlet and outlet of each pump, cooling tower, condenser, chiller, coiling connections and where shown on the drawings. All connectors shall be suitable for use at the temperature, pressure, and service encountered at the point of installation and operation. End fitting connectors shall conform to the pipefitting schedule. Control rods or protective braid must be used to limit elongation to 3/8". Flexible connectors shall not be required for suspended in-line pumps.

## 2.2 MANUFACTURER'S RESPONSIBILITIES:

Manufacturer of vibration and seismic restraint products shall have the following responsibilities:

Determine vibration isolation and seismic restraint sizes and locations.

Provide installation instructions and shop drawings for all materials supplied under this section of the specifications.

Provide calculations to determine equipment restraint loads resulting from seismic forces presented in local building code or IBC, Chapter 16 latest edition. Seismic calculations shall be certified by the manufacturers engineer licensed in the state of Utah.

Seismic restraint load ratings must be certified and substantiated by testing or calculations under direct control of a registered professional engineer.

Calculations and restraint device submittal drawings shall meet the requirements of Part 1, Seismic Design.

## 2.3 QUALITY CONTROL

The isolators and seismic restraint systems listed herein are as manufactured by International Seismic Application Technology (ISAT), Amber / Booth, Mason Industries Inc. (M.I.), Kinetics Noise Control Inc. (K.N.C.), California Dynamics (CalDyn), Vibration Mounting & Controls, Inc. (V.M.C.) and Vibro Acoustics.



Steel components shall be cleaned and painted with industrial enamel. All nuts, bolts and washers shall be zinc-electroplated. Structural steel bases shall be thoroughly cleaned of welding slag and primed with zinc-chromate or metal etching primer.

All isolators, bases and seismic restraints exposed to the weather shall utilize weather resistant plating, epoxy coat or PVC coated springs and galvanized steel components. Nuts, bolts and washers may be zinc-electroplated. Isolators for outdoor mounted equipment shall provide adequate restraint for the greater of either wind loads required by local codes or withstand a minimum of 30 lb. / sq. ft. applied to any exposed surface of the equipment.

Vibration isolation designer must provide a written special inspection plan as indicated in Chapter 17 of the IBC.

## 2.4 SUBMITTALS

Submit shop drawings of all isolators, seismic restraints and calculations provided.

The manufacturer of vibration isolation products shall submit the following data for each piece of isolated equipment: clearly identified equipment tag, quantity and size of vibration isolators and seismic restraints for each piece of rotating isolated equipment. Submittals for mountings and hangers incorporating springs shall include spring diameter and free height, rated deflections, and solid load. Submittals for bases shall clearly identify locations for all mountings as well as all locations for attachment points of the equipment to the mounting base. Submittals shall include seismic calculations signed and checked by a qualified licensed engineer in the state where the project is being constructed. Catalog cut sheets and installation instructions shall be included for each type of isolation mounting or seismic restraint used on equipment being isolated.

Submit special inspection requirements as required under 2.4 at time of isolator/seismic submittals. Submittal must be stamped by a registered Utah professional engineer who is responsible for the vibration isolation and seismic restraint design. All vibration isolation not complying with this certification will be rejected.

Submittal documents must include a "Basis for Design" or "Design Criteria" which includes a statement from the registered design professional that the design complies with the requirements of the ASCE 7-05, Chapter 13 and IBC 2015 chapter 1912/ACI 318 (concrete anchors). In addition, the basis for compliance must also be noted, as listed below:

- Project specific design documentation prepared and submitted by a registered design professional (ASCE 7, 13.2.1.1)
- Submittal of the manufacturer's certification that the isolation equipment is seismically qualified by:
  - o An engineered analysis conforming to the requirements of Chapter 13 of ASCE 7.
  - o Testing by a nationally recognized testing standard procedure such as ICC-ES AC 156. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

- Experience data conforming to a nationally recognized procedure. The substantiated seismic design capacities shall exceed the seismic demands determined by Section 13.3 of ASCE 7.

## 2.5 VIBRATION ISOLATION PRODUCTS

### ISOLATORS

Specification W: a pad type mounting consisting of two layers of ribbed elastomeric pads with a ½” poro-elastic vibration absorptive material bonded between them. Pads shall be sized for approximate deflection of 0.10” to 0.18”. Pads shall be Amber / Booth Type NRC or equal.

Specification A: an elastomeric mounting having a steel baseplate with mounting holes and a threaded insert at top of the mounting for attaching equipment. All metal parts shall be completely embedded in the elastomeric material. Mountings shall be designed for approximately 1/2” deflection, and incorporate a steel seismic snubber with all directional restraint. Mountings shall be Amber/Booth Type SRVD or equal.

Specification B: an adjustable, freestanding, open spring mounting with combination leveling and equipment fastening bolt. The spring shall be welded to the spring mounting baseplate and compression plate for stability. The isolator shall be designed for a minimum  $k_x/k_y$  (horizontal-to-vertical spring rate) of 1.0. An elastomeric pad having a minimum thickness of 1/4” shall be bonded to the baseplate. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. This type isolator must be used with specification SL seismic restraint (section 2.3.1). Isolators shall be Amber/Booth Type SW or equal.

Specification C: a unitized adjustable, stable open spring isolator with a seismic restraint housing which serves as a blocking device during equipment installation. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. The springs shall be designed for a minimum  $k_x/k_y$  (horizontal-to-vertical spring rate) of 1.0. Nuts, adjusting bolts and washers shall be zinc-electroplated to prevent corrosion. The spring assembly shall be removable with equipment in place and shall fit within a welded steel enclosure consisting of a top plate and rigid lower housing. Isolated seismic restraint bolts shall connect top plate to lower housing to resist seismic and wind forces in all directions and limit motion to a maximum of 1/4” movement before engaging. Surfaces that engage under seismic motion shall be cushioned with a resilient elastomeric pad or grommet to protect equipment. Top plate shall have adequate means for fastening to the equipment, and baseplate shall have adequate means for bolting to structure. Entire assembly shall be rated to exceed the applied seismic load (para 1.3.4.). Seismic isolator shall be Amber/Booth Type CTER or equal.

Specification D: an elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment and an elastomeric isolation element designed for approximately 1/2” deflection. Hangers shall be Amber/Booth Type BRD or equal.

Specification E: a combination spring and elastomeric hanger consisting of a rectangular steel box capable of 200% minimum overload without visible deformation, 30 degree rod misalignment, coil spring, spring retainers and elastomeric element designed for approximately 1/2” deflection. The spring shall be designed for a minimum  $k_x/k_y$  (horizontal-to-vertical spring rate) of 1.0. Spring hangers shall be Amber/Booth Type BSRA or equal.

Specification F: a set (two or more) of spring thrust resisting assemblies, which consist of coil springs, spring retainer, isolation washer, angle mounting brackets, and elastomeric tubing for

isolating thrust resister rod from fan discharge. Thrust restraints shall be Amber / Booth Type TRK or equal.

Specification SB: a unitized adjustable open spring isolator and a welded steel housing designed to resist seismic forces in all directions. Restraint surfaces which engage under seismic motion shall be cushioned with a resilient elastomer to protect equipment. Restraints shall allow a maximum of 1/4" movement before engaging and shall allow for the spring to be changed if required. Isolator shall be a stable spring with a minimum  $k_y/k_y$  of 1.0. The spring package shall include an elastomeric pad for high frequency absorption at the base of the spring. Nuts and bolts shall be zinc-electroplated to prevent corrosion. Bolting equipment to isolator with bolts smaller than main adjusting bolt will not be allowed.

Base plate shall provide means for bolting to the structure. Entire assembly shall be rated to exceed the applied seismic load. Mountings shall be Amber/Booth Type SWSR or equal.

## BASES

Specification G: a welded integral structural steel fan and motor base with NEMA standard motor slide rails and holes drilled to receive the fan and motor slide rails. The steel members shall be adequately sized to prevent distortion and misalignment of the drive, and specifically, shall be sized to limit deflection of the beam on the drive side to 0.05" due to starting torque. Snubbers to prevent excessive motion on starting or stopping shall be furnished if required; however, the snubbers shall not be engaged under steady running conditions. Bases shall be Amber/Booth Type SFB or equal.

Specification H: a welded WF (main member) structural steel base for increasing rigidity of equipment mounted thereon or for unitizing belt driven fans. Fan bases shall have holes drilled to match fan and located to provide required center distance between fan and supplied NEMA standard motor slide rails. The steel members shall have minimum depth of 1/12" of the longest span, but not less than 6" deep. Junior beams and junior channels shall not be used. Cross members shall be provided where necessary to support the equipment or to prevent twisting of the main members. Where height restrictions prevent the use of members having a depth of 1/12 of the longest span, beams of less depth may be used provided they have equal rigidity. Provide height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the precompression type to limit exposed bolt length. Bases shall be Amber/Booth Type WSB or equal.

Specification J: a concrete inertia base consisting of perimeter structural steel concrete pouring form (CPF), reinforcing bars welded in place, bolting templates with anchor bolts and height-saving brackets for side mounting of the isolators. Brackets for use with Specification type B isolators having 2.5" deflection or greater shall be of the pre-compression type to limit exposed bolt length. The perimeter steel members shall have a minimum depth of 1/12 of the longest span, but not less than 6" deep. The base shall be sized with a minimum overlap of 4" around the base of the equipment and, in the case of belt-driven equipment, 4" beyond the end of the drive shaft. Fan bases are to be supplied with NEMA standard motor slide rails. The bases for pumps shall be sized to support the suction elbow of end suction pumps and both the suction and discharge elbows of horizontal split-case pumps. The bases shall be T-shaped where necessary to conserve space. Inertia bases shall be Amber/Booth Type CPF or equal.

## FLOOR MOUNTED EQUIPMENT SEISMIC RESTRAINTS:

Specification SL: a restraint assembly for floor mounted equipment consisting of welded steel interlocking assemblies welded or bolted securely to the equipment or the equipment bases and to the supporting structure. Restraint assembly surfaces which engage under seismic motion shall be lined with a minimum 1/4" thick resilient elastomeric pad to protect equipment. Restraints shall be field adjustable and be positioned for 1/4" clearance as required to prevent interference during normal operation. Restraint assembly shall have minimum rating of 2 times the catalog rating at 1 G as certified by independent laboratory test. Restraint shall be Amber/Booth Type ER or equal.

#### ROOFTOP UNIT CURBS AND ISOLATION SYSTEMS

Specification W: Non-isolated seismically rated rooftop curb system that is flashed into roofing membrane. Air and watertight curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. Curb must provide means to positively anchor to concrete deck, or bolt or weld directly to structural steel to withstand seismic loading. Curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Curb shall use minimum 16 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.4.) or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Seismic curbs shall be Amber/Booth Type RTC or equal.

Specification X: An extruded aluminum rail base for roof top air conditioning units consisting of top and bottom weatherproofed aluminum rails for mounting between equipment and roof curb, incorporating wind/seismic restraints and a continuous air and water seal which is protected from accidental puncture and direct sunlight by an aluminum weather shield. Rails shall incorporate free standing, open spring isolators (minimum kx/ky of 1.0) properly spaced and sized around perimeter for the deflection listed in the isolation schedule. To prevent leaks, rails shall be factory assembled (to the limits of freight carriers) and shipped as a one-piece unit. Where spliced, corners to be factory assembled. Specification X rails may only be used where wind/seismic restraint are capable of withstanding seismic forces per paragraph 1.3.4. Seismic design of the curb supporting the isolation rail shall be provided by the roof curb manufacturer. Rails shall be Amber/Booth Type RTIR or equal.

Specification Y: Seismically rated rooftop isolation curb system that is flashed into roofing membrane. Standard unit curb will not be used. Air and watertight upper curb shall have a neoprene sponge seal at the top and be rigid enough provide continuous perimeter support for rooftop unit. The upper curb shall be supported by type C isolators welded or bolted to continuous structural support which is positively anchored to concrete deck or bolted or welded to the structure to withstand seismic loading. An EPDM nylon reinforced airtight weatherproof seal shall consolidate the upper and lower curbs. Weatherproof access doors shall be provided at each isolator to allow isolator adjustment. Isolation curb shall provide a means by which contractor supplied insulation may be installed for thermal insulation and acoustic attenuation. Curbs shall accommodate roof pitch shown on drawings. Isolation curb shall use minimum 16 gage galvanized steel and shall be designed with crossbracing required to withstand the greater of seismic forces (para 1.3.4.) or wind loading per local building code. Design must be certified by registered professional engineer in the employ of the manufacturer. Isolation curbs shall be Amber/Booth Type RTIC or equal.

#### FLEXIBLE PIPE CONNECTIONS

Specification K: Water Service: For flanged connection – a double sphere arch rubber expansion joint constructed of molded reinforced neoprene with integral steel floating flanges, and designed to be suitable for pressures up to 225 PSI (4 to 1 safety factor) and temperatures up to 225 °F. Connectors shall have minimum movement capabilities of 1.77” compression, 1.18” lateral and 1.18” extension. Connectors shall provide a minimum 35° angular movement up to 6”, minimum 30° up to 12” and minimum 20° up to 24”. Spring-loaded control units shall be furnished to limit movement to within allowables. Amber/Booth Type 2600 or equal.

Water Service: For threaded type – A double spherical rubber hose connector, minimum 8” long, constructed of molded neoprene, nylon cord reinforced, with female pipe unions each end. Connectors shall have a minimum movement capability of 7/8” compression, 7/8” lateral, 1/4” extension and 20° angular through 1-1/4”, 13° through 2”, and 9° through 3”. Connectors shall be suitable for a maximum working pressure (4 to 1 safety factor) of 150 psi and 225 degree F. Connectors shall have cable control units to limit extension to 1/4”. Amber/Booth Type 2655 or equal.

Specification L: Steam and Condensate Service:

For flanged connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Live lengths shall conform to hose minimum length to absorb thermal and dynamic movement. Hose axis must be perpendicular to pipe movement. Amber/Booth Type SS-FP or SS-FW or equal.

For threaded connections - a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Minimum lengths shall conform to the following table:

1-1/2” dia. (and smaller) x 10” long
2” x 12”
2-1/2” x 13”
3” x 14”
3-1/2” x 16”
4” x 16”

Amber/Booth Type SS-PM or equal.

Air Compressor Vacuum Service

For flanged connection – a flanged metal hose connector constructed of stainless steel hose and braid with carbon steel plate flanges. Connector shall be double braided with a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-FP (Special) or equal.

For threaded connection – a metal hose connector constructed of stainless steel hose and braid with carbon steel NPT threaded end fittings. Connector shall be double braided and have a minimum live length equal to four times the diameter. Connector shall be installed with the long axis perpendicular to the motion to be absorbed. Amber/Booth Type SS-PM (special) or equal.

## PIPE GUIDES AND ANCHORS FOR ISOLATED PIPING

Specification M: For Pipe Guides where specifically shown on drawings to accommodate expansion loops and compensators, the vibration isolator manufacturer shall provide pipe guides consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum, half inch thickness of heavy duty neoprene and duck or elastomeric isolation material. Guides shall be Amber/ Booth type AG or equal.

Specification N: For anchors where specifically shown on drawings to accommodate expansion loops and compensators, the vibration isolator manufacturer shall provide all directional acoustical pipe anchors consisting of a telescopic arrangement of two sizes of steel tubing separated by a minimum half inch thickness of heavy duty neoprene and duck or elastomeric isolation material. All-directional anchors shall be Amber/Booth type AG or equal.

## 2.6 EXECUTION

Isolator and seismic restraints shall be installed as recommended by the manufacturer. Isolate all mechanical equipment 0.75 hp and over per the isolation schedule and these specifications.

## PIPING ISOLATION

Horizontal Pipe Isolation: all HVAC pumped water, pumped condensate, glycol, and refrigerant piping size 1-1/4" and larger within mechanical rooms shall be isolated. Outside equipment rooms this piping shall be isolated for the greater of 50' or 100 pipe diameters from rotating equipment. For the first 3 support locations from externally isolated equipment provide specification E hangers or specification SB or SX floor mounts with the same deflection as equipment isolators (max 2"). All other piping within the equipment rooms shall be isolated with the same specification isolators with a 3/4" minimum deflection. Steam piping size 1-1/4" and larger which is within an equipment room and connected to rotating equipment shall be isolated for three (3) support locations from the equipment. Provide specification E or SB (SX) isolators with the same deflection as the equipment but a minimum of 3/4"

All plumbing pumped water, pumped condensate, and steam piping size 1-1/4" and larger within mechanical rooms shall be isolated the same as HVAC piping (para. 3.2.1). Isolators are not required for any plumbing pumped water, pumped condensate, and steam piping outside of mechanical rooms unless listed in the isolation schedule (para. 3.5.5.)

Pipe Riser Isolation: All variable temperature vertical pipe risers 1-1/4" and larger, riser piping requiring isolation per para. 3.2.1 or 3.2.2 or where specifically shown and detailed on riser drawings shall be fully supported by specification B mounts with precompression plates. Steel spring deflection shall be 3/4-inch minimum except in those locations where added deflection is required due to pipe expansion and contraction. Spring deflection shall be a minimum of 4 times the anticipated deflection change. Springs shall be selected to keep the riser in tension. Pipe risers up through 16" shall be supported at intervals of every third floor of the building. Pipe risers 18" and over, every second floor. Wall sleeves for take-offs from riser shall be sized for insulation O.D. plus two times the anticipated movement to prevent binding. Horizontal take-offs and at upper and lower elbows shall be supported with spring isolators as required to accommodate anticipated movement. In addition to submittal data requirements previously outlined, riser diagrams and calculations shall be submitted for approval. Calculations must show anticipated expansion and contraction at each support point, initial and final loads on the building structure, and spring deflection changes. Submittal data shall include certification that the riser

system has been examined for excessive stresses and that none will exist if installed per design proposed. Riser supports shall be Amber/Booth Type SWP or equal.

#### DUCT ISOLATION:

Isolate all duct work with a static pressure 2" W.C. and over in equipment rooms and to minimum of 50 feet from the fan or air handler. Use specification type E hangers or type SB (SX) floor mounts or equal.

## 2.7 INSTALLATION

Comply with manufacturer's instructions for the installation and load application of vibration isolation materials and products. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary support during installation or shipping.

Locate isolation hangers as near the overhead support structure as possible.

Adjust leveling devices as required to distribute loading uniformly on isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.

Install isolated inertia base frames and steel bases on isolator units as indicated so that a minimum of 2 inch clearance below base will result when supported equipment has been installed and loaded for operation.

Roof curbs shall be installed directly to building structural steel or concrete roof deck. Installation on top of steel deck or roofing material is not acceptable.

#### APPLICATION OF SEISMIC RESTRAINTS

All floor mounted isolated equipment shall be protected with type SB or type C unitized isolator and restraint or with separate type SL restraints (minimum of 4) in conjunction with type B isolators. For equipment with high center of gravity additional cable restraints shall be furnished, as required by isolation manufacturer, to limit forces and motion caused by rocking.

Floor mounted which are exempt (section 2.2.) shall be protected by properly sized anchor bolts with elastomeric grommets provided by the isolation manufacturer

Where riser pipes pass through cored holes, core diameters to be a maximum of 2" larger than pipe O.D. including insulation. Cored holes must be packed with resilient material or firestop as provided by other sections of this specification or local codes. Restrained isolators type C or SB shall support risers and provide longitudinal restraint at floors where thermal expansion is minimal and will not bind isolator restraints.

#### QUALITY ASSURANCE

Representative of vibration isolation system manufacturer to walk the project and provide documentation indicating conformance to vibration isolation design intent (see example below)

<b>EQUIPMENT ISOLATION SCHEDULE (1)(4)</b>
--

EQUIPMENT	LOCATION								
	A' CRITICAL (35'-50' SPAN)			B' UPPER STORY (20'-35' SPAN)			C' GRADE		
	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE (1) TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE (1) TYPE	ISOLATOR TYPE	MINIMUM DEFLECTION (IN)	BASE (1) TYPE
AIR HANDLING UNITS FLOOR MOUNTED									
UP TO 15 HP	SWSR	1.5		SWSR	0.75		SWSR	0.75	
20 HP & OVER	SWSR	2.5	WSB	SWSR	1.5		SWSR	0.75	
SUSPENDED (4)									
UP TO 15 HP	PBSRA	1.75		BSRA	1		BSRA	1	
20 HP & OVER	PBSRA	2.5	WSB	PBSRA	1.75		PBSRA	1	
HIGH PRESSURE FAN SECTIONS (2)									
UP TO 30 HP	SW	2.5	CPF	SWIS WSR	1.5	CPF	SWIS WSR	0.75	CPF
40 HP & OVER	SW	3.5	CPF	SWIS WSR	2.5	CPF	SWIS WSR	1.5	CPF
CENTRIFUGAL FANS CL. I & II UP TO 54-112" W.D.									
UPT015HP	SWIS WSR	1.5	SFB	SWIS WSR	0.75	SFB	SWIS WSR	0.75	SFB
20-50 HP	SW	2.5	CPF	SWIS WSR	1.5	CPF	SWIS WSR	0.75	SFB
60 HP & OVER	SW	3.5	CPF	SW	2.5	CPF	SWIS WSR	1.5	SFB
CL. I & II 60" W.D. & OVER ALL CL. III FANS									
UPT015HP	SW	2.5	CPF	SWIS WSR	1.5	CPF	SWIS WSR	0.75	CPF
20-50 H P	SW	2.5	CPF	SW	2.5	CPF	SWIS WSR	1.5	CPF
60 HP & OVER	SW	3.5	CPF	SW	2.5	CPF	SWIS WSR	1.5	CPF
AXIAL FLOWFANS (2) FLOOR MTD.									
UP TO 15 HP	SWIS WSR	1.5	WSB	SWSR	0.75		SWSR	0.75	
20 HP & OVER	SW	3.5	CPF	SWSR	1.5		SWSR	0.75	



SUSPENDED (4)									
UP TO 15 HP	PBSRA	1.75	WSB	BSR A	1		BSR A	1	
20 HP & OVER	PBSRA	2.5	WSB	PBSR A	1.75	WSB	PBSR A	1.5	
VENT (UTILITY SETS)									
FLOOR MTD	SWIS WSR	1.5	WSB	SWS R	0.75		SWSR	0.75	
SUSPENDED (4)	BSRA	1.75	WSB	BSR A	1		BSRA	0.75	
CABINET FANS, FANS SECTIONS (2)									
FLOOR MTD.									
UP TO 15 HP	SWSR	1.5		SWSR	0.75		SWSR	0.75	
20 HP & OVER	SW	2.5	CPF	SWSR	1.5		SWSR	0.75	
SUSPENDED (4)									
UP TO 15 HP	PBSRA	1.75		BSR A	1		BSRA	0.75	
20 HP & OVER	PBSRA	2.5	WSB	PBSR A	1.75		BSRA	1.75	
PUMPS									
FLOOR MTD.									
UP TO 15 HP	SWIS WSR	0.75	CPF	SWIS WSR	0.75	CPF	SRVD	0.4	CPF
7-1/2 HP & OVER	SWIS WSR	1.5	CPF	SWIS WSR	1.5	CPF	SWIS WSR	0.75	CPF
SUSPENDED INLINE	PBSRA	1.75		PBSRA	1.75		PBSRA	1	
REFRIGERATION UNITS									
RECIPROCATING COMPRESSORS	SW	2.5	CPF	SWIS WSR	1.5	CPF	SWIS WSR	0.75	CPF
RECIPROCATING CONDO UNITS & CHILLERS	SW	2.5	CPF	CTER	1.5		SWSR	0.75	
HERMETIC CENTRIFUGALS	CTER	2.5		CTER	1.5		NRC	0.15	
OPEN CENTRIFUGALS	SW	2.5	CPF	SWIS WSR	1.5	CPF	NRC	0.15	
ABSORPTION MACHINES	CTER	1.5		CTER	0.75		NRC	0.15	
AIR COMPRESSORS									
TANK TYPE (HORIZONTAL TANK)	SW	2.5	CPF	SWSR	1.5		SWS R	0.75	
TANK TYPE (VERTICAL TANK)	SW	2.5	CPF	SWIS WSR	1.5	CPF	SWS R	0.75	
COOLING TOWERS & CLOSED CIRCUIT COOLERS									
UP TO 500 TONS	CTE R	2.5	(3)	CTER	0.75	(3)	NRC	0.15	
OVER 500 TONS	CTE R	4.5	(3)	CTER	2.5	(3)	NRC	0.15	

AIR COOLED CONDENSERS UP TO 50 TONS	CTER	1.5	(3)	CTER	0.75	(3)	NRC	0.15	
OVER 50 TONS	CTER	2.5	(3)	CTER	1.5	(3)	NRC	0.15	
ROOFTOP AIR CONDITIONING UNITS REQUIRING WEATHER SEAL									
UP TO 5000 CFM (12 TON)	SW	1.5	RTIR	SW	0.75	RTIR			
OVER 5000 CFM (12 TON)	CTER	2.5	RTIC	CTE R	1.5	RTIC			
OTHER TYPES									
UP TO 25 TONS	CTER	1.5	(3)	CTE R	1.5	(3)			
OVER 25 TONS	CTER	2.5	(3)	CTE R	1.5	(3)			
BOILER (PACKAGE TYPE) ALL SIZES	CTER	1.5		CTER	0.75		NRC	0.15	
ENGINE DRIVEN GENERATORS									
UP TO 60 HP	SW	2.5	CPF	CTE R	1.5	CPF	CTER	0.75	
75 HP & OVER	SW	3.5	CPF	CTE R	2.5	CPF	CTER	0.75	

NOTES:

- 1) WITH TYPE ER SEISMIC SNUBBERS IF SW ISOLATORS ARE USED. NO ADDITIONAL SNUBBER IS REQUIRED FOR SWSR ISOLATORS.
- 2) TYPE TRK THRUST RESISTORS REQUIRED ON ALL HIGH PRESSURE FAN SECTIONS, SUSPENDED AXIAL FLOW FANS AND ON FLOOR MOUNTED AXIAL FANS OPERATING AT 3" S.P. OR GREATER.
- 3) WITH STEEL BASE TYPE WSB IF REQUIRED FOR SUPPORT.

END OF SECTION 23 0548

## SECTION 23 0553 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Equipment labels.
  - 2. Danger, Warning and Caution signs and labels.
  - 3. Pipe labels.
  - 4. Duct labels.
  - 5. Stencils.
  - 6. Valve tags.
  - 7. Danger tags.
  - 8. Warning tags.
  - 9. Caution tags.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

#### 1.4 COORDINATION

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

## PART 2 - PRODUCTS

### 2.1 EQUIPMENT LABELS

#### A. Metal Labels for Equipment:

1. Material and Minimum Thickness, predrilled or stamped holes for attachment hardware:
  - a. **Brass, 0.032-inch .**
2. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
3. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
4. Fasteners: Stainless-steel;
  - a. **Rivets or self-tapping screws**
5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

#### B. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, and having predrilled holes for attachment hardware, **1/16 inch** thick.
2. Letter Color:
  - a. **Black.**
3. Background Color:
  - a. **White.**
4. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.
5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
6. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Fasteners: Stainless-steel;
  - a. **Rivets or self-tapping screws**
8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

#### C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

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

## 2.2 DANGER, WARNING AND CAUTION SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; **1/16 inch** thick.
- B. Danger signs, colors:
  - 1. Letter Color:
    - a. **White.**
  - 2. Background Color:
    - a. **Red.**
- C. Warning signs, colors:
  - 1. Letter Color:
    - a. **Black.**
  - 2. Background Color:
    - a. **Orange.**
- D. Caution signs, colors:
  - 1. Letter Color:
    - a. **Black.**
  - 2. Background Color:
    - a. **Yellow.**
- E. Maximum Temperature: Able to withstand temperatures up to **160 deg F.**
- F. Minimum Label Size: Length and width vary for required label content, but not less **than 2-1/2 by 3/4 inch.**
- G. 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.
- H. Fasteners: Stainless-steel;
  - 1. Rivets or self-tapping screws
  - 2. Rivets.
- I. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- J. Label Content: Include caution and warning information, plus emergency notification instructions.

## 2.3 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to **partially cover** circumference of pipe and to attach to pipe without fasteners or adhesive.

- C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
  - 2. Lettering Size: At least 1-1/2 inches high.

## 2.4 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, having predrilled holes for attachment hardware; **1/16 inch** thick.
- B. Letter Color:
  - 1. **White.**
- C. Background Color:
  - 1. **Black.**
- 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;
  - 1. Rivets or self-tapping screws
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
  - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
  - 2. Lettering Size: At least **1-1/2 inches** high.

## 2.5 STENCILS

- A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of **1-1/4 inches** for ducts; and minimum letter height of **3/4 inch** for access panel and door labels, equipment labels, and similar operational instructions.
  - 1. Stencil Material:

- a. Aluminum .**
  2. Stencil Paint:
    - a. Exterior, gloss, **alkyd enamel** black unless otherwise indicated.
    - b. Paint may be in pressurized spray-can form.
  3. Identification Paint:
    - a. Exterior, **alkyd enamel** in colors according to ASME A13.1 unless otherwise indicated.

## 2.6 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
  1. Tag Material, predrilled or stamped holes for attachment hardware, minimum thickness:
    - a. Brass, 0.032-inch**
  2. Fasteners: Brass;
    - a. Wire-link or beaded chain; or S-hook**
- B. Valve Schedules:
  1. For each piping system, on **8-1/2-by-11-inch** bond paper, tabulate;
    - a. Valve number.
    - b. Piping system.
    - c. System abbreviation (as shown on valve tag).
    - d. Location of valve (room or space).
    - e. Normal-operating position (open, closed, or modulating).
    - f. Variations for identification.
    - g. Mark valves for emergency shutoff and similar special uses.
  2. Valve-tag schedule:
    - a. Shall be included in operation and maintenance data.

## 2.7 DANGER TAGS

- A. Danger Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  1. Size:
    - a. 3 by 5-1/4 inches minimum**
  2. Fasteners:
    - a. Brass grommet and wire.**
  3. Nomenclature: Large-size primary caption such as "DANGER," and "DO NOT OPERATE."
  4. Color: Red background with white lettering.

## 2.8 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size:
    - a. **3 by 5-1/4 inches minimum**
  - 2. Fasteners:
    - a. **Brass grommet and wire.**
  - 3. Nomenclature: Large-size primary caption such as "WARNING" and "DO NOT OPERATE."
  - 4. Color: Yellow background with black lettering.

## 2.9 CAUTION TAGS

- A. Caution Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
  - 1. Size:
    - a. **3 by 5-1/4 inches minimum**
  - 2. Fasteners:
    - a. **Brass grommet and wire.**
  - 3. Nomenclature: Large-size primary caption such as "CAUTION," and "DO NOT OPERATE."
  - 4. Color: Orange background with black lettering.

## PART 3 - EXECUTION

### 3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

### 3.2 EQUIPMENT LABEL INSTALLATION

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

### 3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in **Division 09**.
- B. Stenciled Pipe Label Option:



1. Stenciled labels may be provided instead of manufactured pipe labels, at Installer's option.
  2. Install stenciled pipe labels **with painted, color-coded bands or rectangles** on each piping system.
  3. Install stenciled pipe labels, **complying with ASME A13.1**, on each piping system.
    - a. Identification Paint: Use for contrasting background.
    - b. Stencil Paint: Use for pipe marking.
- C. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Near each valve and control device.
  2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
  3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
  4. At access doors, manholes, and similar access points that permit view of concealed piping.
  5. Near major equipment items and other points of origination and termination.
  6. Spaced at maximum intervals of **50 feet** along each run. Reduce intervals to **25 feet** in areas of congested piping and equipment.
  7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- D. Pipe Label Color Schedule: (See Drawing Schedules)

### 3.4 DUCT LABEL INSTALLATION

- A. Install **plastic-laminated** duct labels with permanent adhesive on air ducts in the following color codes:
1. **Blue** : For cold-air supply ducts.
  2. **Yellow** : For hot-air supply ducts.
  3. **Green** : For exhaust-, outside-, relief-, return-, and mixed-air ducts.
  4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of **50 feet** in each space where ducts are exposed or concealed by removable ceiling system.

### 3.5 VALVE-TAG INSTALLATION (See Drawing Schedules.)

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

3.6 WARNING-TAG INSTALLATION

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

END OF SECTION 23 0553

## SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Balancing Air Systems:
    - a. Variable-air-volume systems.
  - 2. Balancing Hydronic Piping Systems:
    - a. Constant-flow hydronic systems.
    - b. Variable-flow hydronic systems.
    - c. Primary-secondary hydronic systems.
  - 3. Existing Systems.

#### 1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within the following number of days of the Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article;
  - 1. **30 days.**
- B. Certified TAB reports.

C. Instrument calibration reports, to include the following:

1. Instrument type and make.
2. Serial number.
3. Application.
4. Dates of use.
5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by **AABC** or **NEBB**.

1. TAB Field Supervisor: Employee of the TAB contractor and certified by **AABC** or **NEBB** and shall be the same as the TAB Contractor.
2. TAB Technician: Employee of the TAB contractor and who is certified by **AABC** or **NEBB** as a TAB technician and shall be the same as the TAB Contractor.

B. Certify TAB field data reports and perform the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by:

1. **Architect .**

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide **seven** days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on the following distribution systems have been satisfactorily completed:

1. **Air .**
2. **Water .**
3. **Air and water .**

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

A. Subject to compliance with requirements, **engage one of the following:**

1. Bonneville Test and Balance
2. BTC Service.
3. Certified Test & Balance.
4. Diamond Test & Balance.
5. RS Analysis.
6. Test & Balance Inc.
7. Payson Sheetmetal.
8. QT&B Inc.

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine:
1. Ceiling plenums and underfloor air plenums used for supply, return, or relief air to verify that they meet the leakage class of connected ducts as specified in:
    - a. **Section 233113 "Metal Ducts"**
  2. Verify ceiling plenums and underfloor air plenums used for supply, return or relief air are properly separated from adjacent areas.
  3. Verify that penetrations in plenum walls are sealed and fire-stopped if required.
- F. Examine equipment performance data including fan and pump curves.
1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
  2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment

performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

- G. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- H. Examine test reports specified in individual system and equipment Sections.
- I. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- J. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.
- K. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.
- L. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- M. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- N. Examine system pumps to ensure absence of entrained air in the suction piping.
- O. Examine operating safety interlocks and controls on HVAC equipment.
- P. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

### 3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
  - 1. Permanent electrical-power wiring is complete.
  - 2. Hydronic systems are filled, clean, and free of air.
  - 3. Automatic temperature-control systems are operational.
  - 4. Equipment and duct access doors are securely closed.
  - 5. Balance, smoke, and fire dampers are open.
  - 6. Isolating and balancing valves are open and control valves are operational.
  - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
  - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

### 3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in this section and:
  - 1. **AABC's "National Standards for Total System Balance"**
- B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
  - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
  - 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Section 230713 "Duct Insulation," Section 230716 "HVAC Equipment Insulation," and Section 230719 "HVAC Piping Insulation."
- C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in **inch-pound (IP)**.

### 3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.
- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling-unit components.
- L. Verify that air duct system is sealed as specified in Section 23 3113 "Metal Ducts."

### 3.6 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.
  - 2. Measure fan static pressures as follows to determine actual static pressure:
    - a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
    - b. Measure static pressure directly at the fan outlet or through the flexible connection.
    - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
    - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
  - 3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
    - a. Report the cleanliness status of filters and the time static pressures are measured.
  - 4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
  - 5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.
  - 6. Obtain approval from one of the following entities 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:
    - a. **Architect .**
  - 7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.
- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
  - 1. Measure airflow of submain and branch ducts.



- a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
  2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
  3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- 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.

### 3.7 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 a 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.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
  6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
  7. 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.
  8. Record final fan-performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance variable-air-volume systems the same as described for constant-volume air systems.
  2. Set terminal units and supply fan at full-airflow condition.
  3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
  4. Readjust fan airflow for final maximum readings.
  5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
  6. 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.
    - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
  7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
  2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
  3. Set terminal units at full-airflow condition.
  4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to

indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.

5. Adjust terminal units for minimum airflow.
6. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.

### 3.8 PROCEDURES FOR MULTIZONE SYSTEMS

- A. Set unit at maximum airflow through the cooling coil.
- B. Adjust each zone's balancing damper to achieve indicated airflow within the zone.

### 3.9 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data, and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against the approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
  1. Open all manual valves for maximum flow.
  2. Check liquid level in expansion tank.
  3. Check makeup water-station pressure gage for adequate pressure for highest vent.
  4. Check flow-control valves for specified sequence of operation, and set at indicated flow.
  5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
  6. Set system controls so automatic valves are wide open to heat exchangers.
  7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
  8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

### 3.10 PROCEDURES FOR CONSTANT-FLOW HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures except for positive-displacement pumps:
  1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

- a. If impeller sizes must be adjusted to achieve pump performance, obtain approval from the following entity and comply with requirements in Section 232123 "Hydronic Pumps." :
    - 1) **Architect.**
  2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
    - a. Monitor motor performance during procedures and do not operate motors in overload conditions.
  3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
  4. Report flow rates that are not within plus or minus 10 percent of design.
- B. Measure flow at all automatic flow control valves to verify that valves are functioning as designed.
- C. Measure flow at all pressure-independent characterized control valves, with valves in fully open position, to verify that valves are functioning as designed.
- D. Set calibrated balancing valves, if installed, at calculated presettings.
- E. Measure flow at all stations and adjust, where necessary, to obtain first balance.
1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
  2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
  3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure-control-valve settings existing at the conclusion of balancing.
- J. Check settings and operation of each safety valve. Record settings.

### 3.11 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

### 3.12 PROCEDURES FOR TESTING, ADJUSTING, AND BALANCING EXISTING SYSTEMS

- A. Perform a preconstruction inspection of existing equipment that is to remain and be reused.
  - 1. Measure and record the operating speed, airflow, and static pressure of each fan.
  - 2. Measure motor voltage and amperage. Compare the values to motor nameplate information.
  - 3. Check the refrigerant charge.
  - 4. Check the condition of filters.
  - 5. Check the condition of coils.
  - 6. Check the operation of the drain pan and condensate-drain trap.
  - 7. Check bearings and other lubricated parts for proper lubrication.
  - 8. Report on the operating condition of the equipment and the results of the measurements taken. Report deficiencies.
- B. Before performing testing and balancing of existing systems, inspect existing equipment that is to remain and be reused to verify that existing equipment has been cleaned and refurbished. Verify the following:
  - 1. New filters are installed.
  - 2. Coils are clean and fins combed.
  - 3. Drain pans are clean.
  - 4. Fans are clean.
  - 5. Bearings and other parts are properly lubricated.
  - 6. Deficiencies noted in the preconstruction report are corrected.
- C. Perform testing and balancing of existing systems to the extent that existing systems are affected by the renovation work.
  - 1. Compare the indicated airflow of the renovated work to the measured fan airflows, and determine the new fan speed and the face velocity of filters and coils.
  - 2. Verify that the indicated airflows of the renovated work result in filter and coil face velocities and fan speeds that are within the acceptable limits defined by equipment manufacturer.
  - 3. If calculations increase or decrease the air flow rates and water flow rates by more than 5 percent, make equipment adjustments to achieve the calculated rates. If increase or decrease is 5 percent or less, equipment adjustments are not required.
  - 4. Balance each air outlet.

### 3.13 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: **Plus or minus 10 percent .**
2. Air Outlets and Inlets: **Plus or minus 10 percent .**
3. Heating-Water Flow Rate: **Plus or minus 10 percent .**
4. Cooling-Water Flow Rate: **Plus or minus 10 percent .**

### 3.14 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: Prepare progress reports on the following interval to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors;
  1. **Weekly.**

### 3.15 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
  1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
  2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
  1. Pump curves.
  2. Fan curves.
  3. Manufacturers' test data.
  4. Field test reports prepared by system and equipment installers.
  5. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
  1. Title page.
  2. Name and address of the TAB contractor.
  3. Project name.
  4. Project location.
  5. Architect's name and address.
  6. Engineer's name and address.
  7. Contractor's name and address.

8. Report date.
  9. Signature of TAB supervisor who certifies the report.
  10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
  11. Summary of contents including the following:
    - a. Indicated versus final performance.
    - b. Notable characteristics of systems.
    - c. Description of system operation sequence if it varies from the Contract Documents.
  12. Nomenclature sheets for each item of equipment.
  13. Data for terminal units, including manufacturer's name, type, size, and fittings.
  14. Notes to explain why certain final data in the body of reports vary from indicated values.
  15. Test conditions for fans and pump performance forms including the following:
    - a. Settings for outdoor-, return-, and exhaust-air dampers.
    - b. Conditions of filters.
    - c. Cooling coil, wet- and dry-bulb conditions.
    - d. Face and bypass damper settings at coils.
    - e. Fan drive settings including settings and percentage of maximum pitch diameter.
    - f. Inlet vane settings for variable-air-volume systems.
    - g. Settings for supply-air, static-pressure controller.
    - h. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
  2. Water and steam flow rates.
  3. Duct, outlet, and inlet sizes.
  4. Pipe and valve sizes and locations.
  5. Terminal units.
  6. Balancing stations.
  7. Position of balancing devices.
- E. Air-Handling-Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data:
    - a. Unit identification.
    - b. Location.
    - c. Make and type.
    - d. Model number and unit size.
    - e. Manufacturer's serial number.
    - f. Unit arrangement and class.
    - g. Discharge arrangement.
    - h. Sheave make, size in inches, and bore.
    - i. Center-to-center dimensions of sheave, and amount of adjustments in inches.

- j. Number, make, and size of belts.
- k. Number, type, and size of filters.

2. Motor Data:

- a. Motor make, and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.
- e. Sheave make, size in inches, and bore.
- f. Center-to-center dimensions of sheave, and amount of adjustments in inches.

3. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Total system static pressure in inches wg.
- c. Fan rpm.
- d. Discharge static pressure in inches wg.
- e. Filter static-pressure differential in inches wg.
- f. Preheat-coil static-pressure differential in inches wg.
- g. Cooling-coil static-pressure differential in inches wg.
- h. Heating-coil static-pressure differential in inches wg.
- i. Outdoor airflow in cfm.
- j. Return airflow in cfm.
- k. Outdoor-air damper position.
- l. Return-air damper position.
- m. Vortex damper position.

F. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Coil type.
- d. Number of rows.
- e. Fin spacing in fins per inch o.c.
- f. Make and model number.
- g. Face area in sq. ft..
- h. Tube size in NPS.
- i. Tube and fin materials.
- j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outdoor-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.



- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.
- j. Entering-water temperature in deg F.
- k. Leaving-water temperature in deg F.
- l. Refrigerant expansion valve and refrigerant types.
- m. Refrigerant suction pressure in psig.
- n. Refrigerant suction temperature in deg F.
- o. Inlet steam pressure in psig.

G. Gas- and Oil-Fired Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

- a. System identification.
- b. Location.
- c. Make and type.
- d. Model number and unit size.
- e. Manufacturer's serial number.
- f. Fuel type in input data.
- g. Output capacity in Btu/h.
- h. Ignition type.
- i. Burner-control types.
- j. Motor horsepower and rpm.
- k. Motor volts, phase, and hertz.
- l. Motor full-load amperage and service factor.
- m. Sheave make, size in inches, and bore.
- n. Center-to-center dimensions of sheave, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total air flow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Entering-air static pressure in inches wg.
- f. Leaving-air static pressure in inches wg.
- g. Air static-pressure differential in inches wg.
- h. Low-fire fuel input in Btu/h.
- i. High-fire fuel input in Btu/h.
- j. Manifold pressure in psig.
- k. High-temperature-limit setting in deg F.
- l. Operating set point in Btu/h.
- m. Motor voltage at each connection.
- n. Motor amperage for each phase.
- o. Heating value of fuel in Btu/h.

H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:

1. Unit Data:
  - a. System identification.
  - b. Location.
  - c. Coil identification.
  - d. Capacity in Btu/h.
  - e. Number of stages.
  - f. Connected volts, phase, and hertz.
  - g. Rated amperage.
  - h. Air flow rate in cfm.
  - i. Face area in sq. ft..
  - j. Minimum face velocity in fpm.
2. Test Data (Indicated and Actual Values):
  - a. Heat output in Btu/h.
  - b. Air flow rate in cfm.
  - c. Air velocity in fpm.
  - d. Entering-air temperature in deg F.
  - e. Leaving-air temperature in deg F.
  - f. Voltage at each connection.
  - g. Amperage for each phase.

I. Fan Test Reports: For supply, return, and exhaust fans, include the following:

1. Fan Data:
  - a. System identification.
  - b. Location.
  - c. Make and type.
  - d. Model number and size.
  - e. Manufacturer's serial number.
  - f. Arrangement and class.
  - g. Sheave make, size in inches, and bore.
  - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
2. Motor Data:
  - a. Motor make, and frame type and size.
  - b. Horsepower and rpm.
  - c. Volts, phase, and hertz.
  - d. Full-load amperage and service factor.
  - e. Sheave make, size in inches, and bore.
  - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
  - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
  - b. Total system static pressure in inches wg.
  - c. Fan rpm.
  - d. Discharge static pressure in inches wg.
  - e. Suction static pressure in inches wg.
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
  1. Report Data:
    - a. System and air-handling-unit number.
    - b. Location and zone.
    - c. Traverse air temperature in deg F.
    - d. Duct static pressure in inches wg.
    - e. Duct size in inches.
    - f. Duct area in sq. ft..
    - g. Indicated air flow rate in cfm.
    - h. Indicated velocity in fpm.
    - i. Actual air flow rate in cfm.
    - j. Actual average velocity in fpm.
    - k. Barometric pressure in psig.
- K. Air-Terminal-Device Reports:
  1. Unit Data:
    - a. System and air-handling unit identification.
    - b. Location and zone.
    - c. Apparatus used for test.
    - d. Area served.
    - e. Make.
    - f. Number from system diagram.
    - g. Type and model number.
    - h. Size.
    - i. Effective area in sq. ft..
  2. Test Data (Indicated and Actual Values):
    - a. Air flow rate in cfm.
    - b. Air velocity in fpm.
    - c. Preliminary air flow rate as needed in cfm.
    - d. Preliminary velocity as needed in fpm.
    - e. Final air flow rate in cfm.
    - f. Final velocity in fpm.
    - g. Space temperature in deg F.
- L. System-Coil Reports: For reheat coils and water coils of terminal units, include the following:
  1. Unit Data:

- a. System and air-handling-unit identification.
- b. Location and zone.
- c. Room or riser served.
- d. Coil make and size.
- e. Flowmeter type.

2. Test Data (Indicated and Actual Values):

- a. Air flow rate in cfm.
- b. Entering-water temperature in deg F.
- c. Leaving-water temperature in deg F.
- d. Water pressure drop in feet of head or psig.
- e. Entering-air temperature in deg F.
- f. Leaving-air temperature in deg F.

M. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump rpm.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

N. Instrument Calibration Reports:

1. Report Data:
  - a. Instrument type and make.
  - b. Serial number.
  - c. Application.
  - d. Dates of use.
  - e. Dates of calibration.

3.16 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
  - a. Measure airflow of at least **10** percent of air outlets.
  - b. Measure water flow of at least **5** percent of terminals.
  - c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
  - d. Verify that balancing devices are marked with final balance position.
  - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by:
  - a. **Architect .**
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of:
  - a. Architect .
3. The following entity shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day:
  - a. **Architect .**
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:

1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
  2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.17 ADDITIONAL TESTS

- A. Within **90 days** of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION 23 0593

## SECTION 23 0700 - DUCT INSULATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes semirigid and flexible duct, plenum, and breeching insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 7 Section "Firestopping" for firestopping materials and requirements for penetrations through fire and smoke barriers.
  - 2. Division 23 Section "Equipment Insulation" for insulation materials and application for pumps, tanks, hydronic specialties, and other equipment.
  - 3. Division 23 Section "Pipe Insulation" for insulation for piping systems.
  - 4. Division 23 Section "Metal Ducts" for duct liner.

#### 1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Removable insulation sections at access panels.
  - 2. Application of field-applied jackets.
  - 3. Applications at linkages for control devices.
- C. 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.
- D. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

#### 1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
  - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
  - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

#### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.

#### 1.6 COORDINATION

- A. Coordinate clearance requirements with duct Installer for insulation application.

#### 1.7 SCHEDULING

- A. Schedule insulation application after testing duct systems. Insulation application may begin on segments of ducts that have satisfactory test results.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.



2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.
  3. Closed-Cell Phenolic-Foam Insulation:
    - a. Kooltherm Insulation Products, Ltd.
  4. Calcium Silicate Insulation:
    - a. Owens-Corning Fiberglas Corp.
    - b. Pabco.
    - c. Schuller International, Inc.
  5. Calcium Magnesium Silicate Fire Rated Blanket:
    - a. 3M Fire Protection
    - b. Thermal Ceramics
    - c. Fire Master
    - d. Fyrewarp
- 2.2 INSULATION MATERIALS
- A. Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, without facing and with all-service jacket manufactured from aluminum foil.
  - B. Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II, without facing and with all-service jacket manufactured from aluminum foil.
- 2.3 ACCESSORIES AND ATTACHMENTS
- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
    1. Tape Width: 4 inches.
  - B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
    1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
    2. Galvanized Steel: 0.005 inch thick.
    3. Aluminum: 0.007 inch thick.
    4. Brass: 0.010 inch thick.
    5. Nickel-Copper Alloy: 0.005 inch thick.

- C. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- D. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
  - 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- E. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
  - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.

## 2.4 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.
  - 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. PVC Jacket Color: Color-code to match connected piping jackets based on materials contained within the piping system.
- C. Aluminum Jacket: Deep corrugated sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness and corrugation dimensions are scheduled at the end of this Section.
  - 1. Finish: Smooth or Stucco-embossed finish.
  - 2. Moisture Barrier: 1-mil- thick, heat-bonded polyethylene and kraft paper.

## 2.5 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## 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.
- B. 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.

### 3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of ducts and fittings.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each duct system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.

- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Joints and Seams: Cover with tape and vapor retarder as recommended by insulation material manufacturer to maintain vapor seal.
  - 3. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to duct flanges and fittings.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on ducts and plenums scheduled to receive vapor retarders.
  - 1. Ducts with Vapor Retarders: Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
  - 2. Ducts without Vapor Retarders: Overlap insulation facing at seams and secure with outward clinching staples and pressure-sensitive tape having same facing as insulation.
- O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.
  - 1. Seal penetrations with vapor-retarder mastic.
  - 2. Apply insulation for exterior applications tightly joined to interior insulation ends.
  - 3. Seal insulation to roof flashing with vapor-retarder mastic.
- P. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and partitions, except fire-rated walls and partitions.
- Q. Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire/smoke damper sleeves for fire-rated wall and partition penetrations.
- R. Floor Penetrations: Terminate insulation at underside of floor assembly and at floor support at top of floor.
  - 1. For insulation indicated to have vapor retarders, taper termination and seal insulation ends with vapor-retarder mastic.

### 3.4 MINERAL-FIBER INSULATION APPLICATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.

1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not overcompress insulation during installation.
  4. Impale insulation over anchors and attach speed washers.
  5. 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.
  6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
  7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
  8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
  10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.
- B. Board Applications for Ducts and Plenums: Secure board insulation with adhesive and anchor pins and speed washers.
1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
  2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  3. Space anchor pins as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.

- c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
  - d. Do not overcompress insulation during installation.
- 4. 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. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1 inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
  - 6. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch- wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
  - 8. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

### 3.5 DUCT SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Insulate the following plenums and duct systems:
  - 1. Indoor supply-, return-, mixed-, and outside-air ductwork and plenums.
  - 2. Indoor range-hood exhaust ductwork.
  - 3. Indoor oven and dishwasher exhaust ductwork.
- D. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  - 1. Fibrous-glass ducts.
  - 2. Metal ducts with duct liner.
  - 3. Factory-insulated flexible ducts.
  - 4. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
  - 5. Flexible connectors.
  - 6. Vibration-control devices.
  - 7. Testing agency labels and stamps.
  - 8. Nameplates and data plates.
  - 9. Access panels and doors in air-distribution systems.

### 3.6 INDOOR DUCT APPLICATION SCHEDULE

- A. Service: Round, flat oval and rectangular medium pressure and low pressure round, supply-air and outside air and mixed air ducts, concealed (Including inside fan rooms).
  - 1. Material: Mineral-fiber blanket
  - 2. Thickness: 1-1/2 inches.
  - 3. Number of Layers: One.
  - 4. Jacket: Reinforced Foil.
  - 5. Vapor Retarder Required: Yes.
- B. Service: Round, flat, oval and rectangular, medium pressure, supply-air, outside air, and mixed air (exposed).
  - 1. Material: Mineral-fiber blanket.
  - 2. Thickness: 1-1/2 inches.
  - 3. Number of Layers: One.
  - 4. Jacket: Aluminum
  - 5. Vapor Retarder Required: Yes.
- C. Service: Rectangular, range-hood exhaust ducts, concealed.
  - 1. Material: Calcium Magnesium Silicate Blanket
  - 2. As required for 2 fire rating by NRTL acceptable to authority having jurisdiction.
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Polypropylene Aluminum Foil.
  - 5. Vapor Retarder Required: No
- D. Service: Rectangular, range-hood exhaust ducts, exposed, kitchen exhaust duct.
  - 1. Material: Calcium Magnesium Silicate Blanket
  - 2. As required for 2 fire rating by NRTL acceptable to authority having jurisdiction.
  - 3. Field-Applied Jacket: Polypropylene Aluminum Foil with Aluminum Jacket.
  - 4. Vapor Retarder Required: No
- E. Service: Rectangular, dishwasher exhaust ducts, concealed.
  - 1. Material: Calcium Magnesium Silicate Blanket
  - 2. Thickness: 1-1/2 inches.
  - 3. Number of Layers: One.
  - 4. Jacket: Reinforced foil.
  - 5. Vapor Retarder Required: No.
- F. Service: Rectangular, dishwasher exhaust ducts, exposed.
  - 1. Material: Mineral-fiber board.
  - 2. Thickness: 2 inches
  - 3. Number of Layers: One.
  - 4. Field-Applied Jacket: Aluminum.

5. Vapor Retarder Required: No.

END OF SECTION 23 0700



## SECTION 23 0719 - HVAC PIPING 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 insulating the following HVAC piping systems:
  - 1. Heating hot-water piping.

#### 1.3 DEFINITIONS:

- A. Refer to Section 230500 "Common Work Results for HVAC".

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
  - 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.
  - 6. Detail application of field-applied jackets.
  - 7. Detail application at linkages of control devices.

#### 1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. 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.

#### 1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

- B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

- 1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
- 2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

#### 1.7 DELIVERY, STORAGE, AND HANDLING

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

#### 1.8 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

#### 1.9 SCHEDULING

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

## PART 2 - PRODUCTS

### 2.1 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.
- B. Insulation for below-ambient service requires a vapor-barrier.
- 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 C 871.
- E. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- F. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- G. Calcium Silicate:
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Industrial Insulation Group (IIG); Thermo-12 Gold.
  - 2. Preformed Pipe Sections: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 3. Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with a non-asbestos fibrous reinforcement. Comply with ASTM C 533, Type I.
  - 4. Prefabricated Fitting Covers: Comply with ASTM C 450 and ASTM C 585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
- H. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Aeroflex USA, Inc.; Aerocel.
  - b. Armacell LLC; AP Armaflex.
  - c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553,
  1. Type II and ASTM C 1290, Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  2. Products: Subject to compliance with requirements, provide one of the following:
    - a. CertainTeed Corp.; SoftTouch Duct Wrap.
    - b. Johns Manville; Microlite.
    - c. Knauf Insulation; Friendly Feel Duct Wrap.
    - d. Manson Insulation Inc.; Alley Wrap.
    - e. Owens Corning; SOFTR All-Service Duct Wrap.
- J. Mineral-Fiber, Preformed Pipe Insulation:
  1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Johns Manville; Micro-Lok.
    - b. Knauf Insulation; 1000-Degree Pipe Insulation.
    - c. Manson Insulation Inc.; Alley-K.
    - d. Owens Corning; Fiberglas Pipe Insulation.
    - e. Type I, **850 deg F** Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, **Type I, Grade A:**
      - 1) with factory-applied ASJ-SSL. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

- K. Mineral-Fiber, Pipe and Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied:
  - 1. **ASJ** complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is **2.5 lb/cu. ft.** or more. Thermal conductivity (k-value) at **100 deg F** is **0.29 Btu x in./h x sq. ft. x deg F** or less. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
  - 2. See Editing Instruction No. 1 in the Evaluations for cautions about naming manufacturers and products. See Section 016000 "Product Requirements."
  - 3. Products: Subject to compliance with requirements, provide one of 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.
- L. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.

## 2.2 INSULATING CEMENTS

- A. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Ramco Insulation, Inc.; Super-Stik.
- B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
  - 1. Products: Subject to compliance with requirements, provide the following:
    - a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

## 2.3 ADHESIVES

- A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Calcium Silicate Adhesive: Fibrous, sodium-silicate-based adhesive with a service temperature range of **50 to 800 deg F**.
  - 1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-97.
    - b. Eagle Bridges - Marathon Industries; 290.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-27.
    - d. Mon-Eco Industries, Inc.; 22-30.
    - e. Vimasco Corporation; 760.
  - 2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Flexible Elastomeric 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 LLC; Armaflex 520 Adhesive.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-75.
    - d. K-Flex USA; R-373 Contact Adhesive.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
    - d. Mon-Eco Industries, Inc.; 22-25.
  2. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- E. ASJ Adhesive, and FSK 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 Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
    - b. Eagle Bridges - Marathon Industries; 225.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
    - d. Mon-Eco Industries, Inc.; 22-25.



2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the following:
  - a. Dow Corning Corporation; 739, Dow Silicone.
  - b. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
  - c. P.I.C. Plastics, Inc.; Welding Adhesive.
  - d. Speedline Corporation; Polyco VP Adhesive.
2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 MASTICS

- A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.
  1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-80/30-90.
    - b. Vimasco Corporation; 749.
  2. Water-Vapor Permeance: ASTM E 96/E 96M, Procedure B, **0.013 perm** at **43-mil** dry film thickness.
  3. Service Temperature Range: **Minus 20 to plus 180 deg F.**
  4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
  5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
    - b. Eagle Bridges - Marathon Industries; 570.
    - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
  2. Water-Vapor Permeance: ASTM F 1249, **0.05 perm** at **30-mil** dry film thickness.
  3. Service Temperature Range: **Minus 50 to plus 220 deg F.**
  4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
  5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
    - b. Eagle Bridges - Marathon Industries; 550.

- c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
  - d. Mon-Eco Industries, Inc.; 55-50.
  - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, **1.8 perms** at **0.0625-inch** dry film thickness.
3. Service Temperature Range: **Minus 20 to plus 180 deg F.**
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

## 2.5 SEALANTS

### A. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide the following:
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 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, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

## 2.6 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-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

## 2.7 FIELD-APPLIED JACKETS

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

1. Products: Subject to compliance with requirements, **provide one of the following:**
  - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Metal Jacketing Systems.
  - b. ITW Insulation Systems; Aluminum and Stainless Steel Jacketing.
  - c. RPR Products, Inc.; Insul-Mate.
2. Aluminum Jacket: Comply with **ASTM B 209**, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
  - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
  - b. Finish and thickness are indicated in field-applied jacket schedules.
  - c. Moisture Barrier for Indoor Applications:
    - 1) **1-mil-** thick, heat-bonded polyethylene and kraft paper.
  - d. Moisture Barrier for Outdoor Applications:
    - 1) **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.

## 2.8 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. ABI, Ideal Tape Division; 428 AWF ASJ.
    - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    - c. Compac Corporation; 104 and 105.
    - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
  2. Width: **3 inches**.
  3. Thickness: **11.5 mils**.
  4. Adhesion: **90 ounces force/inch** in width.
  5. Elongation: 2 percent.
  6. Tensile Strength: **40 lbf/inch** in width.
  7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.
- B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
    - a. ABI, Ideal Tape Division; 370 White PVC tape.
    - b. Compac Corporation; 130.
    - c. Venture Tape; 1506 CW NS.
  2. Width: **2 inches**.
  3. Thickness: **6 mils**.
  4. Adhesion: **64 ounces force/inch** in width.
  5. Elongation: 500 percent.
  6. Tensile Strength: **18 lbf/inch** in width.

## 2.9 SECUREMENTS

- A. Staples: Outward-clinching insulation staples, nominal **3/4-inch-** wide, stainless steel or Monel.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

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

### 3.2 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 piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.

3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
1. Draw jacket tight and smooth.
  2. Cover circumferential joints with **3-inch-** wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced **4 inches o.c.**
  3. Overlap jacket longitudinal seams at least **1-1/2 inches**. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at
    - a. **2 inches o.c.**
    - b. **4 inches o.c.**
    - c. For below-ambient services, apply vapor-barrier mastic over staples.
  4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
  5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least **4 inches** beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
  2. Testing agency labels and stamps.
  3. Nameplates and data plates.
  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 Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
  - 1. Pipe: Install insulation continuously through floor penetrations.
  - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

### 3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least **2 inches** over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

### 3.6 INSTALLATION OF CALCIUM SILICATE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure single-layer insulation with stainless-steel bands at **12-inch** intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least **3 inches**. Secure inner layer with wire spaced at **12-inch** intervals. Secure outer layer with stainless-steel bands at **12-inch** intervals.
3. Apply a skim coat of mineral-fiber, hydraulic-setting cement to insulation surface. When cement is dry, apply flood coat of lagging adhesive and press on one layer of glass cloth or tape. Overlap edges at least **1 inch**. Apply finish coat of lagging adhesive over glass cloth or tape. Thin finish coat to achieve smooth, uniform finish.

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 block insulation of same material and thickness as pipe insulation.
4. Finish flange insulation same as pipe insulation.

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 insulation sections of insulation are not available, install mitered sections of calcium silicate insulation. Secure insulation materials with wire or bands.
3. Finish fittings insulation same as pipe insulation.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install mitered segments of calcium silicate insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Install insulation to flanges as specified for flange insulation application.
3. Finish valve and specialty insulation same as pipe insulation.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

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

### 3.8 INSTALLATION OF MINERAL-FIBER INSULATION

#### A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at **6 inches** o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

#### B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least **1 inch**, and seal joints with flashing sealant.

#### C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

#### D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

### 3.9 FIELD-APPLIED JACKET INSTALLATION

#### A. Where PVC jackets are indicated, install with **1-inch** overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

- B. Where metal jackets are indicated, install with **2-inch** overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands **12 inches** o.c. and at end joints.

### 3.10 FINISHES

- A. Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
  - 1. Flat Acrylic Finish: **Two** finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
    - a. Finish Coat Material: Interior, flat, latex-emulsion size.
  - B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
  - C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
  - D. Do not field paint aluminum or stainless-steel jackets.

### 3.11 PIPING INSULATION SCHEDULE, GENERAL

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

### 3.12 Insulation shall have a k value that meets the minimum requirements of the latest International Energy Conservation Code (IECC).

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Heating-Hot-Water Supply and Return, **200 Deg F** and Below:
  - 1. **NPS 1 1/2** and Smaller: Insulation shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I:
      - 1) 1-1/2 inch thick

2. Greater than **NPS 1-1/2 inch** : Insulation shall be the following:

- a. Mineral-Fiber, Preformed Pipe, Type I or Pipe and Tank Insulation:
    - 1) **2 inches** thick
- 3. Insulation for runouts not exceeding **48 inches** in length for connection to equipment shall be the following:
  - a. Mineral-Fiber, Preformed Pipe, Type I: **1 inch** thick.
- B. Heating-Hot-Water Supply and Return, above **200 Deg F**:
  - 1. **NPS 1** and Smaller: Insulation shall be **one of** the following:
    - a. Calcium Silicate:
      - 1) **2 inches** thick
    - b. Mineral-Fiber, Preformed Pipe, Type I or II:
      - 1) **1-1/2 inches** thick
  - 2. **NPS 1-1/4** and Larger: Insulation shall be **one of** the following:
    - a. Calcium Silicate:
      - 1) **3 inches** thick
    - b. Mineral-Fiber, Preformed Pipe, Type I or II:
      - 1) **2 inches** thick
  - 3. Insulation runouts not exceeding **48 inches** in length for connection to equipment shall be the following:
    - a. Mineral-Fiber, Preformed Pipe, Type I: **1-1/2 inch** thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

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



1. None.
- D. Piping, Exposed:
  1. **PVC:**
    - a. Color-Coded by System: **30 mils** thick, match the existing color scheme.

END OF SECTION 23 0719

## SECTION 23 0900 – HVAC INSTRUMENTATION AND CONTROLS

### PART 1 - GENERAL

#### 1.1 GENERAL CONDITIONS

- A. The General Conditions, Supplementary General Conditions, alternates and addenda, applicable drawings and the technical specifications, shall all apply to all work under this division.

#### 1.2 SYSTEM DESCRIPTION

- A. A system of DDC automatic temperature controls shall be extended/modified and installed as a part of this contract to give the owner a completely operable system.
- B. Acceptable manufacturers and installers shall be:
  - 1. Alerton by D&L Controls or Alliance Controls.
- C. The DDC system shall tie this facility directly into the District's Ethernet campus wide system. All networking software and DDC interface software shall be provided under this section to seamlessly connect this facility to the network. This contractor shall coordinate with the District's IT department to obtain all IP addresses and network clearances to connect the DDC system to the Ethernet network.
- D. The Host computer software located at the District maintenance office shall be upgraded to the most current revision of INET and each facility located through-out the District that incorporates a TAC system shall be upgraded to the same software revision as the host computer system.
- E. The system shall be as indicated on the drawings and specified herein. Building HVAC systems and unitary heating devices shall be entirely controlled by the DDC system. System shall include local DDC controllers mounted at each fan system, VAV box, fan-coil unit and cabinet unit heater. These local DDC controllers shall be interconnected by a 2-wire LAN (local area network) with a master/central DDC controller located in the Maintenance office. The master/central DDC controller, in turn, shall communicate with the existing school district host computer located in the district offices. The graphics on the computer shall display on separate, bit-mapped color screens each fan system, VAV box, cabinet unit heater, central heating system and central cooling system. Each screen shall have available for display in the appropriate location each input and output point monitored or generated by the DDC system. All digital output points shall have override capability. All screens shall be password protected so that sensitive data cannot be easily corrupted by inexperienced operators while allowing complete access to trained maintenance personnel. All of the above screens, data and features shall also be available for monitoring and modification from the Host computer located in the District offices via a Netplus router.
- F. All system and unitary controls shall be of the direct digital type (DDC). Self-tuning PID (Proportional, Integral, Derivative) control algorithms shall be applied where applicable on all applications. The control system shall be a networked, distributed intelligence system, with the control loops for each system being capable of stand-alone operation.

- G. The system shall include all control devices, valves and damper parts as called for hereinafter.

### 1.3 SCOPE

- A. The control system shall consist of electronic type, direct digital controllers, input/output modules, ATC interface panels, and accessory equipment for a completely installed system of automatic temperature controls and motor starting circuit control.

### 1.4 WORK TO BE PERFORMED BY OTHERS

- A. Division 16 shall furnish and install all single phase and multiple phase electrical power wiring to magnetic starters, disconnect switches, VFD's and motors. They shall also provide 120 VAC, 20 Ampere power sources to each group of ATC panels and VAV boxes as shown on the electrical plans. The ATC contractor shall be responsible for all 24 VAC wiring to ATC equipment.
- B. The sheet metal contractor shall install all dampers supplied by the ATC contractor. Each damper shall be installed so that it will operate freely and without binding. To insure that the damper both opens and closes completely with less than 7#/sq. ft. torque applied at the operating shaft, each damper shall be checked after its installation, but before the damper actuators are attached. Dampers not properly installed or meeting this torque requirement shall be replaced and/or reinstalled without additional cost to the ATC contractor or the School District.
- C. The mechanical contractor shall install all valves, immersion wells and pressure taps supplied him by the ATC contractor.

### 1.5 INSTALLATION BY AUTOMATIC TEMPERATURE CONTROL (ATC) CONTRACTOR

- A. The ATC contractor shall furnish and install all necessary electrical control wiring for the complete temperature control system, heating and ventilating equipment motor starting circuit controls and all electrical control interlocks for same, and for control wiring for miscellaneous HVAC equipment furnished by the Owner.
- B. The ATC contractor shall furnish & install all necessary electrical control wiring of all temperature controls, heating and ventilating equipment motor starting circuit controls, all electrical control interlocks for same and for miscellaneous packaged equipment.
- C. All line and low voltage electrical and control wiring shall be installed in EMT conduit in all areas. The use of plenum cable above the ceiling is only permitted in the cable tray. Conduit piping to the cable tray is permitted.

### 1.6 QUALITY ASSURANCE

- A. Provide an unconditional TWO-YEAR parts and service warranty. This warranty shall commence at the time of demonstration of system completion of all portions of the ATC system.
- B. Emergency response by contractor shall be available 24 hrs/day 7 days/week 365 days/yr. Response time shall not be greater than 12 hours from time of call.

- C. All parts and material and their installation methods shall be in accordance with the manufacturer's recommendations and specifications. All parts and material shall be new.
- D. The Contracting firm executing the work of this section shall have at least 5 years' in business and experienced in completing work of similar scope and nature to that specified. The firm shall be a licensed electrical contractor in the state of Utah. The contractor shall be a local authorized agent of the DDC system manufacturer.

#### 1.7 SUBMITTAL AND TECHNICAL INFORMATION

- A. Submit shop drawings (6 sets) and manufacturer's data for the following items to the mechanical engineer:
  - 1. Wiring and installation diagrams.
  - 2. ATC device specification sheets
  - 3. Point list
  - 4. Control flow diagrams, complete with all control schematics and sequences of operation.
  - 5. Documentation of all software and hardware. These manuals shall be complete with installation procedures as well as start up and programming instructions. They should also contain any testing or maintenance procedures required to operate system on a continuing basis.

#### 1.8 PROJECT COMPLETION REQUIREMENTS

- A. Upon completion of the project, the ATC contractor shall spend the necessary time with the building's operating personnel to adequately instruct them on the operation of the system. These training sessions shall be scheduled at times convenient to the School District and shall be conducted at the project.
- B. Provide 4 copies of the project operating and maintenance instruction manuals for use during the training sessions. Each manual shall contain both a current hard copy and a CD Rom of all DDC system programming.
- C. The ATC contractor shall provide as part of his contract the on-site services of a programmer familiar with the system for an additional 24 hours, which the Engineer and/or the School District may use as they see fit to fine-tune or add features to the system.
- D. The ATC contractor shall provide as part of his contract the on-site services of a technician familiar with the system to assist the air & water balance contractor in completing his portion of the project. The technician shall be available for a minimum of an additional 32 hours for this assistance.
- E. Operation & Maintenance Manuals: Provide 4 manuals in addition to those manuals specified above. These manuals shall provide descriptions of maintenance procedures for all system components, including sensors and controlled devices. They shall cover inspection, periodic preventative maintenance, fault diagnosis, and repair or replacement of defective components. They shall include complete as-built ATC installation drawings with sequences of operation for all mechanical systems controlled by the ATC contractor. They shall each include both a hard copy & diskettes of all as-built system programming.

## PART 2 - EQUIPMENT

### 2.1 CONTROLLERS

- A. Schneider Electric Inet Controls or Alerton BACNet systems shall be utilized as specifically indicated and specified elsewhere in this specification.
- B. All main level controller inputs shall have at least 12 bit A/D converters for input accuracy. Less resolution is unacceptable for main level controllers or any controllers using an air monitoring station or monitoring building pressure. All main level controller outputs shall have board mounted hand-off-auto switches for output override capability.
- C. The contractor shall utilize and employ only the following controllers for any central plant systems and air handling units. A single controller shall be designated with all programming and I/O for each system. This will allow stand alone equipment operation in the event of communications failure. Connection of multiple small controllers or combined operation of application specific devices (ASD or ASC) with other programmable controllers on air handlers and central plant equipment is not permitted.
  - 1. MNL controllers (Schneider Electric)
  - 2. VLCA-1688 controllers (Alerton)
- D. All application specific devices shall utilize and employ only the following controllers for any application specific devices (ASD) such as rooftop units, unitary equipment, etc. (this excludes variable air volume terminal box controllers) No Substitutions are allowed:
  - 1. MNL controllers (Schneider Electric)
  - 2. VLC-1188, VLC 853 or VLC 550 controllers (Alerton)
- E. The only Variable Air Volume box controllers allowed for VAV applications are as follows. No substitutions.
  - 1. MNL (Schneider Electric)
  - 2. VAViH-SD (Alerton)
- F. Direct Digital Control Systems and Approved Installing Contractors:
  - 1. Schneider Electric Control System (formerly TAC) as installed by Utah-Yamas Controls Inc.
  - 2. Alerton BACtalk installed by manufacturers listed above

### 2.2 DISTRICT INTEGRATION

- A. Controls using Backnet shall use a (JACE/UNC) as a global controller. The only global controllers allowed are either a Honeywell JACE-600 or a UNC-520-2. No substitutions are allowed,
  - 1. Sufficient resource space and processor allocation shall be insured to account for the quantity of nodes connected to the JACE/UNC global controller. If needed additional JACE/UNC global controllers shall be added to insure that proper resource space and processor allocations exist. In such a case, then a Web Supervisor or IA Enterprise Server must be added at the local school to properly

integrate the JACE/UNC global controllers. Node licensing will be included to accomplish this.

2. This specification requires the use of JACE/UNC at the local school level for the Building Automation System (BAS). It also requires that the BAS is seamlessly connected through the Wide Area Network (WAN) to a fully implemented District Level Head End System located at the District Offices. This is required to be either a Web Supervisor Workstation (with WS-1 available from Tridium) or a IA Enterprise Server (with IA-ENT-1 available from Schneider Electric) loaded and running on the server computer with corresponding GUI and global services implemented. This may be connected to the existing District Head End System server located in the District offices. If a compatible Head End System Workstation does not already exist, then the BAS contractor is required to supply the necessary computer, software, programming and setup to establish a new Head End System server at the District Offices.
  3. The local global controller (JACE/UNC) that will be connected to the existing or new Head End server shall provide all necessary software and the connection or node licenses to accomplish this.
- B. Controls using Inet shall use a 527 Netplus router capable of alarm notification and graphics hosting.
1. Sufficient resource space and processor allocation shall be insured to account for the quantity of graphics and alarm points used.

## 2.3 DDC INPUT DEVICES

- A. All DDC input devices shall provide industry standard signals and shall be compatible with the DDC controllers used.
- B. All temperature input devices shall have a rated accuracy of 1% or better.
- C. All pressure input devices shall have a rated accuracy of 2% or better. Pressure transmitters shall be selected to match the application, and shall not be damaged by pressures at five times the maximum measurable pressure.
- D. Miscellaneous input devices shall have accuracy's as individually specified.

## 2.4 DDC OUTPUTS

- A. Modulating outputs shall be in accordance with industry standards and shall be compatible with the driven DDC devices.
- B. DDC digital outputs shall be either relay contact closures or Triacs (ASC devices) rated for the application.
- C. All outputs on PCU controllers shall be relay style. Analog outputs shall use relays with pulse-width modulation. This shall allow operator personnel the ability to use manual override switches to manually control the analog devices.
- D. All output transducers converting PWM signals to analog signals shall be Kele PWA-1A type.

## 2.5 AUTOMATIC VALVES

- A. ATC valve bodies 2" and smaller shall be screwed; larger valve bodies shall be flanged. Screwed valves shall be rated at 150 psi or greater and shall have cast iron or brass bodies. Flanged valves shall be rated at 250 psi or greater and have cast iron or steel bodies. All automatic valves shall be for DDC control application.
- B. Shut-off pressure ratings of each valve shall be as required by the application.
- C. The valves shall be manufactured by Belimo, TAC, or Honeywell.

## 2.6 DAMPER AND VALVE ACTUATORS

- A. Damper and valve actuators shall be of the gear-train type. All moving parts shall be permanently lubricated and not require addition or replacement of oil. Actuators shall meet the NEMA 3R rainproof rating and shall have an ambient temperature operating rating of -40°F to 140°F, without the addition of extra equipment. Actuators shall also carry the UL 94-5V rating for installation in return air plenums.
- B. Damper and valve actuators shall accept the appropriate Ma, VDC or digital output signals provided by the DDC controllers.
- C. Damper actuators shall be mounted outside the air stream whenever possible and be of sufficient size to operate the connected damper. Mount damper actuator on firm baseplate.
- D. Damper actuators linked to outdoor air and relief air dampers shall close their attached dampers upon power failure or fan shutdown (spring return).

## 2.7 ROOM TEMPERATURE SENSORS

- A. Wall mounted space temperature thermostats shall be installed in wall boxes and shall be blank plastic cover style.

## 2.8 CO2 LEVEL TRANSMITTERS

- A. The CO2 sensor shall be an Alta Labs CDLSXX type with self-calibrating capability and local CO2 level indication. Output signal shall be 0-5 VDC or 0-10 VDC as required by the DDC system.

## 2.9 AIR FLOW SENSORS

- A. All air flow sensors shall be Ebtron matrix element style and shall be provided by the controls contractor.

## 2.10 PRESSURE SENSORS

- A. All wet and dry pressure sensor transducers shall include a display indicating the pressure reading on the face of the transducer.

## 2.11 HOST COMPUTERS

- A. The School District facility management and control system includes an existing Centralized Host computer currently located at the District offices. The controls contractor shall provide all necessary connections to the existing host computer.
- B. The school district shall provide all necessary IP addresses and a connection port onto their existing Ethernet network.
- C. Copies of all software disks, operation manuals, along with installation instruction shall be provided to owner.
- D. The controlling software database shall be constructed by the ATC contractor to provide a fully operational DDC control system that may be monitored, controlled & modified from the District Centralized Host computer. All control schedules, algorithms, and control logic shall be in place within each DDC controller and stored as back-up copies on both Host computers hard disks which may be down-loaded to individual DDC controllers as necessary. Documentation provided shall include block software flowchart showing the interconnection between each of the control algorithms and sequences.
- E. The building shall be represented by complete graphical floor plans, with accurate locations of each major piece of HVAC equipment. Each major piece of HVAC equipment shall be graphically represented at each Host computer with all appropriate DDC points dynamically represented.
- F. All designated building alarms shall be automatically reported as they occur as determined by the Canyon's School District.

## 2.12 MASTER DDC CONTROL PANEL

- A. The master DDC controller shall provide to the Host computer (s) diagnostic reports of the following types, for all DDC devices:
  - 1. When specified alarm conditions occur, provide a report internally listing the status of specific items associated with the equipment generating the alarm.
  - 2. Report shall be routed to the local Host computer, District Host computer or other combinations of computers via modem as designated by the owner. Depending on the time of day, the owner shall specify up to five sites to which exceptions shall be auto-dialed and reported. This shall allow the owner to assign off hours exception responses to various facility personnel as necessary. Selection of the sites to be dialed can be programmed by the owner, and set to change automatically per time of day and day of week. Information may be duplicated to multiple combinations of locations.
  - 3. Report shall record the time the status information was taken, and shall allow operational personnel to use this information to diagnose the alarm situation.
    - a. Trend logs.
    - b. Energy reports.
    - c. Exception tables/by operator
    - d. Override information table/by operator
    - e. Run time information on equipment
    - f. Review of specific facility information by operators.



- B. All programming defining the functions to be performed by the master DDC control panel from loss due to power failure for a minimum of six months.
- C. The master DDC control panel shall be multi-tasking and shall provide the capability to simultaneously perform at least, but not limited to, the following functions:
  - 1. Down loading of application program changes without affecting the simultaneous operation of existing operating application programming.
  - 2. Operator access to the entire network of local digital controllers.

## 2.13 LOCAL DDC CONTROL PANELS

- A. Local DDC control panels shall be located near mechanical systems as necessary to provide both digital and analog input and output points as specified and/or required to achieve specified system performance.
- B. Each local DDC control panel shall provide all control functions for the mechanical equipment specified to be controlled from that panel.
- C. Every input and output point shall be well labeled and every digital output shall have a LED indication of the position of the output relay.
- D. ATC contractor shall provide documentation of the software application program for each digital controller.
- E. Documentation provided shall include block software flowchart showing the interconnection between each of the control algorithms and sequences.
- F. System acceptance shall not be completed until this documentation is provided and located in each ATC interface panel.
- G. Systems providing modulating outputs via pulse width modulation techniques shall provide within each ATC interface panel all the components required to implement the functions equivalent to an analog output.

## 2.14 ATC INTERFACE PANELS

- A. ATC interface panels shall be mounted near each group of local DDC controllers other than VAV box controllers. Each panel shall be made of not less than 16 gauge steel. Panel shall have a full back plate and full hinged door such that when the door is closed, the assembly provides a completely enclosed, NEMA 1 enclosure. Panels shall be fully painted and fitted with key locks. Appropriately sized nameplates shall be used to identify all panel mounted devices. Major wiring within panels shall be installed within distribution gutters (similar to Panduit). All wiring entering and leaving panels shall terminate on numbered terminal strips. All wiring within panels shall be color coded and the color shall not be changed between the terminal strip and the end destination of that wire. Panels shall contain wiring diagrams of the panel interior and associated devices. Diagrams shall identify all interior devices and shall include terminal numbers.
- B. Panels shall contain the following devices as applicable:
  - 1. Control transformers
  - 2. NEC required fusing

3. Local DDC controllers (contractor option)
4. NEC required grounding
5. Logic relays
6. 120 VAC convenience outlet
7. Air pressure transmitters
8. Control switches
9. Pilot lights
10. Terminal strips

## 2.15 WIRING

- A. All main controller LAN and sub-LAN wiring shall be 18 ga twisted pair shielded wire with the shields grounded in one location as per TAC factory specifications.
- B. All inputs to the DDC controllers (AI's, DI's, etc) shall be in shielded wire with the shields grounded at the controller end. The shields on the sensor end shall be cut and taped.
- C. All analog outputs from the Kele PWA-1A transducers shall be in shielded wire with the shields grounded at the controller end. The shields on the device end shall be cut and taped.

## 2.16 LABELING

- A. All ATC supplied devices shall be permanently labeled with labels indicating device name, system identifier and function within the system. All labels external of the DDC controls cabinets shall be of the engraved type.

## PART 3 - SEQUENCE OF OPERATION

All settings specified below are initial settings only and must be field adjusted to satisfy actual jobsite conditions.

### 3.01 VAV BOX CONTROL W/ REHEAT COILS & OCCUPANCY SENSOR

- A. Room space temperature sensing shall be from wall-mounted temperature sensing elements with adjustable set points (Slide-stats).
- B. A duct style temperature sensor shall be installed at each VAV box air discharge.
- C. Each VAV box shall be connected to the motion sensor provided by division 16 for lighting control. The occupancy sensor through the DDC system and a maintained time delay relay shall return the VAV box back to a standby state when no motion is sensed for 30 minutes (adjustable). The VAV box heating (and cooling) set points shall be decreased (and increased) by two degrees when a VAV box is in standby mode. Also, in standby mode the VAV box minimum CFM set point shall be zero and the fraction of fresh outside air required by the VAV box shall be subtracted from the minimum outside air set point of the air handler.

- D. All VAV boxes shall be programmed to occupied mode each morning the building is scheduled for occupancy until 8:00 am to allow the building to warm-up or purge as required. After 8:00 am, the motion sensors in each room shall determine occupancy of the VAV box.
- E. A VAV box-mounted DDC controller shall be provided for control and operation of each VAV box. The controller shall modulate the VAV box primary air damper between minimum ventilation position and maximum designed airflow and modulate the reheat coil valve and the perimeter radiant heater valve in sequence to maintain the desired space temperature. Heating and cooling set points shall be individually adjustable from the man-machine interface device (Host computer) or the District offices.
- F. The primary air damper of the VAV box shall be capable of reversing operation as required for building warm-up or central plant heat applications.
- G. Each VAV box DDC controller shall have a 24-volt power connection with all 24-volt control wiring by the ATC contractor. Transformers for the VAV controllers shall be centrally located in the respective air handler equipment room for easy access.
- H. Each VAV interface controller shall be loaded to a maximum capacity of 90%. 10% spare space shall be provided to allow for expansion and additional programming.

### 3.02 EXISTING ALERTON DDC CONTROLS

- A. All existing control functions other than those noted to be modified shall be maintained. Existing controls, wiring, etc. shall be protected during construction. Anything damaged will need to be repaired or replaced.

END OF SECTION 23 0900

## SECTION 23 2113 - HYDRONIC PIPING

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section includes pipe and fitting materials and joining methods for the following:
  - 1. Hot-water heating piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Steel pipe and fittings.
  - 2. Copper pipe, tubing and fittings.

3. Dielectric fittings.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides, hangers and supports for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.
2. Locations of pipe anchors and alignment guides and expansion joints and loops.
3. Locations of and details for penetrations, including sleeves and sleeve seals for exterior walls, floors, basement, and foundation walls.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
  2. Other building services.
  3. Structural members.
- B. Qualification Data: For Installer.
- C. Welding certificates.
- D. Field quality-control reports: Written reports as specified in Part 3 of this section including:
1. Test procedures used.
  2. Test results showing compliance with specified requirements.
  3. Failed test results with corrective action taken to achieve compliance with specified requirements.

## 1.5 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation.
  - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

## 1.6 COORDINATION

- A. Coordinate layout and installation of hydronic piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.
- B. Coordinate pipe sleeve installations for foundation wall penetrations.
- C. Coordinate piping installation with roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7 Sections.
- D. Coordinate pipe fitting pressure classes with products specified in related sections.
- E. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 3 Sections.
- F. Coordinate installation of pipe sleeves for penetrations through exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 7 Section "Through-Penetration Firestop Systems" for fire and smoke wall and floor assemblies.

## PART 2 - PRODUCTS

### 2.1 COPPER TUBE AND FITTINGS

- A. **Drawn-Temper Copper Tubing: ASTM B 88, Type L.**

### 2.2 STEEL PIPE AND FITTINGS

- A. Steel Pipe: ASTM A 53, black steel with plain ends; welded and seamless, Grade B, and wall thickness as indicated in "Piping Applications" Article.
- B. Cast-Iron Threaded Fittings: ASME B16.4; Classes 125 and 250 as indicated in "Piping Applications" Article.
- C. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in "Piping Applications" Article.
- D. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in "Piping Applications" Article.
- E. Cast-Iron Pipe Flanges and Flanged Fittings: ASME B16.1, Classes 25, 125, and 250; raised ground face, and bolt holes spot faced as indicated in "Piping Applications" Article.
- F. Wrought-Steel Fittings: ASTM A 234, wall thickness to match adjoining pipe.
- G. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:
  - 1. Material Group: 1.1.
  - 2. End Connections: Butt welding.

3. Facings: Raised face.

H. Forged Steel “Olet” Type Fittings, Welding, Socket-Welding and Threaded: ASME B16.11 and ASTM A105.

1. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

I. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

## 2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch (3.2-mm) maximum thickness unless otherwise indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BA9-1, silver alloy for joining copper with bronze or steel.

E. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

## 2.4 DIELECTRIC FITTINGS

A. General: Assembly or fitting with insulating material isolating joined dissimilar metals, to prevent galvanic action and stop corrosion.

1. Manufacturers:

a. Advance Products & Systems, Inc.

b. Calpico, Inc. Capitol Manufacturing Co.



- c. Capitol Manufacturing Company.
  - d. Central Plastics Company.
  - e. Elster Perfection.
  - f. Grinnell Mechanical Products.
  - g. Matco-Norca.
  - h. Pipeline Seal and Insulator, Inc.
  - i. Precision Plumbing Products, Inc.
  - j. Victaulic Company.
  - k. Watts Regulator Co.
  - l. Zurn Industries, LLC.
- B. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld-neck end types and matching piping system materials.
- C. Insulating Material: Suitable for system fluid, pressure, and temperature.
- D. **End Connections:** Threaded, or flanged.
- E. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and **300-psig** minimum working pressure at **225 deg F**.
- F. Dielectric Nipples or Waterways: Electroplated steel with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and **300-psig** minimum working pressure at **225 deg F**.

### PART 3 - EXECUTION

#### 3.1 PIPING APPLICATIONS

- A. Hot-water heating piping, aboveground, NPS 2 and smaller shall be **[any of]** the following:
- 1. **Type L** drawn-temper copper tubing, wrought-copper fittings, and **soldered** joints.
  - 2. **Schedule 40**, Grade B, Type 96 steel pipe; **Class 125, cast-iron** fittings; cast-iron flanges and flange fittings; and threaded joints.
- B. Hot-water heating piping, aboveground, NPS 2-1/2 and larger, shall be **[any of]** the following:
- 1. **Type L**, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
  - 2. **Schedule 40** steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.
  - 3. Retain "any of" option in first paragraph below to allow Contractor to select piping materials from those retained.

#### 3.2 PIPING INSTALLATIONS

- A. PRE-WORK / PRE-REQUISITES

1. 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.
2. The Contractor shall study the architectural, structural, mechanical, electrical and other drawings to eliminate conflict of piping with other structure lighting or other services.

B. CONDITION

1. All installed pipe lines shall be free from dents, scars, and burrs, with ends reamed smooth.
2. All piping shall be clean and free from acids and loose dirt when installed and shall be kept clean during the completion of the installation.
3. Install piping free of sags and bends.
4. All installed pipe lines shall remain straight against strains tending to cause distortion during system operation. The contractor shall make proper allowance for pipe line

expansion and contraction so that no unsightly distortion, noise, damage or improper operation results therefrom.

C. SELECTION

1. Select system components with pressure rating equal to or greater than system operating pressure.
2. No street type fittings shall be used.
3. No short nipples shall be used except at drain valves.
4. Plugs of rags, wools, cottons, waste, or similar materials may not be used for plugging.

D. ROUTING/ARRANGEMENT

1. Piping installations shall be neatly organized.
2. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
3. Install groups of pipes parallel to each other.
4. Install piping spaced to permit application of insulation.
5. Install piping parallel and spaced to permit the servicing of valves.
6. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls or axis of the building.
7. Diagonal runs are prohibited unless specifically indicated otherwise.
8. Install fittings for all changes in direction.
9. No piping shall be run above any electrical panels, electrical equipment or access clearances for electrical for electrical panels or equipment. No piping shall be allowed to run through any electrical rooms.
10. Piping shall be arranged, placed and installed to facilitate equipment maintenance and shall be so arranged to not interfere with the installation of the air-conditioning equipment, ducts, or the removal of other equipment or devices. All specialties shall be so placed to permit easy operation and access.
11. All piping shall be so installed to insure noiseless circulation.
12. Install fittings for all branch connections.
13. Unless otherwise indicated, install branch connections to mains using tee fittings or forged steel branch fittings in main pipe, with the branch connected to the bottom of the main pipe.

14. For up-feed risers, connect the branch to the top of the main pipe.
15. Forged branch fittings shall be installed per the manufacturer's recommendations.

E. ACCESS / ARRANGEMENT

1. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal. All piping shall be so arranged to not block access to manholes, access openings, etc.
2. Install piping at indicated slopes. If not indicated, install piping at a uniform grade of 0.2 percent where possible, upward in direction of flow. Traps are to be avoided where-ever possible.
3. Reduce pipe sizes using eccentric reducer fitting installed with level side up.
4. When insulated pipes are supported by a roller hanger they shall be protected from damage by suitable pipe covering protection saddles. Saddles shall support pipe on roller and shall be packed with insulation.
5. Install valves according to Section 230523 "General-Duty Valves for HVAC Piping."
6. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, at each coil on all sides of automatic valves where valves do not have union connections, elsewhere as indicated, and wherever necessary to prevent undue difficulty in making repairs or replacement. Unions are not required at flanged connections.
7. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated. Install flanges on valves, apparatus, and equipment having 2 1/2 inch NPS and larger connections. Flanges or unions as applicable for the type of piping specified, shall be provided in the piping at connections to all items of equipment.
8. Install shutoff valve immediately upstream of each dielectric fitting. Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
9. Comply with requirements in Section 230516 "Expansion Fittings and Loops for HVAC Piping" for installation of expansion loops, expansion joints, anchors, and pipe alignment guides. Anchor piping for proper direction of expansion and contraction.
10. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."
11. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

12. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."
13. Install strainers on supply side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4" nipple and ball valve in blow-down connection of strainers NPS 2" and larger. Match size of strainer blow-off connection for strainers smaller than NPS 2").
14. Install flexible connectors at inlet and discharge connections to pumps (except inline pumps) and other vibration-producing equipment.
15. Polypropylene pipe in or passing through plenums must be fire wrapped or installed in a metal conduit.

F. DRAINAGE

1. Drain valves shall be installed at all low points in all piping systems to allow for complete drainage of piping systems.
2. Install drains, consisting of a tee fitting, NPS 3/4" ball valve, and short NPS 3/4" threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.
3. All piping systems shall be installed so that they can be easily drained by means of drainage of low points of all piping without disconnecting pipe.
4. If not specifically indicated on the drawings, the frequency of draining shall determine whether drain caps, plugs, cocks, or valves are to be used.

G. IDENTIFICATION

1. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.

3.3 DIELECTRIC FITTING INSTALLATION

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

1. **Install dielectric nipples or waterways** in piping NPS 2" and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install **waterways**, in piping NPS 2-1/2" and larger, adjacent to flanged valves and at final connection to each piece of equipment.
3. Install Dielectric Fittings into Hydronic Piping Systems: Install dielectric nipples, waterways or couplings to connect piping materials of dissimilar metals.

4. **End Connections: Threaded, or flanged.**

3.4 HANGERS AND SUPPORTS

- A. Comply with requirements in Section 230529 "Hangers and Supports for HVAC Piping and Equipment" for hanger, support, and anchor devices. Comply with the following requirements for maximum spacing of supports.
- B. Comply with requirements in Section 230548 "Vibration and Seismic Controls for HVAC" for seismic restraints.
- C. Steel roof deck shall not be used to support loads from piping, ductwork or equipment, unless noted otherwise. Hanger loads less than 50 lbs. may be hung from the steel roof deck in cases when hanging from the steel roof deck cannot be avoided; the attachment method must distribute the load across the deck as approved by the Structural Engineer.
- D. Install the following pipe attachments:
  - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
  - 2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
  - 3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
  - 4. Spring hangers to support vertical runs.
  - 5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
  - 6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- E. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
  - 1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 2. NPS 1: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  - 3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.

4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
  5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 1/2 inch.
  6. NPS 3 and Larger: Maximum span, 12 feet; minimum rod size, 1/2 inch.
- F. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
  2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
  3. NPS 1-1/4: Maximum span, 7 feet; minimum rod size, 3/8 inch.
  4. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  5. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
  6. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
  7. NPS 3 and Larger: Maximum span, 10 feet; minimum rod size, 3/8 inch.
- G. PVC and CPVC Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- H. PP Piping Hanger Spacing: Install vinyl-coated hangers with the following maximum horizontal spacing and minimum rod diameters:
1. NPS 1 and Smaller: 36 inches with 3/8-inch rod.
  2. NPS 1-1/4 to NPS 2: 48 inches with 3/8-inch rod.
  3. NPS 2-1/2 to NPS 3-1/2: 48 inches with 1/2-inch rod.
  4. NPS 4 and NPS 5: 48 inches with 5/8-inch rod.
  5. NPS 6: 48 inches with 3/4-inch rod.
  6. NPS 8: 48 inches with 7/8-inch rod.
  7. Space all sizes of fiberglass composite reinforced PP pipe according to the manufacturer's written instructions.
- I. Install supports for vertical PP piping every 60 inches for NPS 1 and smaller, and every 72 inches for NPS 1-1/4 and larger.
- J. Fiberglass Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.
- K. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.
- L. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.
- 3.5 PIPE JOINT CONSTRUCTION
- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
  - B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

- C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
  - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
  - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- F. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.
- G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

### 3.6 TERMINAL EQUIPMENT CONNECTIONS

- A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.
- B. Install control valves in accessible locations close to connected equipment.

### 3.7 FIELD QUALITY CONTROL

- A. Prepare hydronic piping according to ASME B31.9 and as follows:
  - 1. Leave joints, including welds, uninsulated and exposed for examination during test.
  - 2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
  - 3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
  - 4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
  - 5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.
- B. Perform the following tests on hydronic piping:



1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
  2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
  3. Isolate expansion tanks and determine that hydronic system is full of water.
  4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times the "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
  5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
  6. Prepare written report of testing.
- C. Perform the following before operating the system:
1. Open manual valves fully.
  2. Inspect pumps for proper rotation.
  3. Set makeup pressure-reducing valves for required system pressure.
  4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
  5. Set temperature controls so all coils are calling for full flow.
  6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
  7. Verify lubrication of motors and bearings.

END OF SECTION 23 2113

## SECTION 23 2116 - HYDRONIC PIPING SPECIALTIES

### 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 special-duty valves and specialties for the following:
  - 1. Hot-water heating piping.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following:
  - 1. Valves: Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
  - 2. Air-control devices.
  - 3. Hydronic specialties.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air-control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

#### 1.5 QUALITY ASSURANCE

- A. Pipe Welding: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
  - 1. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

### PART 2 - PRODUCTS

#### 2.1 VALVES

- A. **Globe, Check, Ball, and Butterfly Valves:** Comply with requirements specified in Section 230523 "General-Duty Valves for HVAC Piping. Gate valves are not allowed on this project.

- B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 230900 "Instrumentation and Control for HVAC.
- C. Refer to Part 3 "Valve Applications" Article for applications of each valve.
- D. Bronze, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 and smaller:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Armstrong Pumps, Inc.
    - b. Bell & Gossett Domestic Pump.
    - c. Flow Design Inc.
    - d. Gerand Engineering Co.
    - e. Griswold Controls.
    - f. Taco.
    - g. Tour & Andersson; available through Victaulic Company.
    - h. Tyco-Grinnell
  - 2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
  - 3. Ball: Brass or stainless steel.
  - 4. Plug: Resin.
  - 5. Seat: PTFE.
  - 6. End Connections: Threaded or socket.
  - 7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
  - 8. Handle Style: Lever, with memory stop to retain set position.
  - 9. CWP Rating: Minimum **125 psig**.
  - 10. Maximum Operating Temperature: **250 deg F**.
- E. Cast-Iron or Steel, Calibrated-Orifice or Venturi, Balancing Valves, NPS 2 ½ and larger:
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Amtrol, Inc.
    - b. Armstrong Pumps, Inc.
    - c. Bell & Gossett Domestic Pump.
    - d. Flow Design Inc.
    - e. Gerand Engineering Co.
    - f. Grinnell.
    - g. Griswold Controls.
    - h. Taco.
    - i. Tour & Andersson; available through Victaulic Company.
    - j. Spence Engineering Company Inc.
    - k. Watts Regulator Co.
  - 2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
  - 3. Ball: Brass or stainless steel.
  - 4. Stem Seals: EPDM O-rings.
  - 5. Disc: Glass and carbon-filled PTFE.

6. Seat: PTFE.
7. End Connections: Flanged or grooved.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum **125 psig**.
11. Maximum Operating Temperature: **250 deg F**.

F. Diaphragm-Operated, Pressure-Reducing Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Conbraco Industries, Inc.
  - e. Spence Engineering Company, Inc.
  - f. Watts Regulator Co.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Diaphragm-Operated Safety Valves: ASME labeled.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Conbraco Industries, Inc.
  - e. Kunkle.
  - f. Spence Engineering Company, Inc.
2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: **Brass**, removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.

10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

H. Automatic Flow-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong Pumps, Inc.
  - b. Bell & Gossett Domestic Pump.
  - c. Flow Design Inc.
  - d. Griswold Controls.
  - e. Taco
2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Tamper proof, self-cleaning, and removable, for inspections and replacement.
  - a. **Corrosion resistant.**
4. Combination Assemblies: Include bronze or brass-alloy ball valve.
5. Identification Tag: Attached by chain and marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations:
  - a. **Minimum CWP Rating: 175 psig.**
8. **Maximum Operating Temperature: 200 deg F.**
9. Fitted with pressure and temperature test valves.
10. Equipped with a readout kit including flow meter, probes, hoses, flow charts, and carrying case.

2.2 AIR-CONTROL DEVICES

A. Manual Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Body: Bronze.
3. Internal Parts: Nonferrous.
4. Operator: Screwdriver or thumbscrew.
5. Manually operated with ball valve in the down position.
6. Inlet Connection: **NPS 1/2.**

7. Discharge Connection: **NPS 1/8**.
8. CWP Rating: **150 psig**.
9. Maximum Operating Temperature: **225 deg F**.

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Bell & Gossett Domestic Pump.
  - c. Hoffman Specialty ITT; Fluid Handling Div.
  - d. Spirax-Sarco.
  - e. Spirovent.
  - f. Taco, Inc.
  - g. Honeywell-Baukman.
2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
4. Operator: Noncorrosive metal float.
5. Inlet Connection: **NPS 1/2**.
6. Discharge Connection: **NPS 1/4**.
7. CWP Rating: **150 psig**.
8. Maximum Operating Temperature: **240 deg F**.

C. **Bladder** -Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
  - e. Zilmet
2. Tank: Welded steel, rated for **125-psig** working pressure and **240 deg F** maximum operating temperature. Factory test after taps are fabricated and supports installed and are labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. **Bladder** : Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.
4. Air-Charge Fittings: Schrader valve, stainless steel with EPDM seats.
5. Access: Drain fitting and taps for pressure gage.
6. Support:
  - a. Vertical tanks with steel legs or base.
  - b. Horizontal tanks with steel saddles.

D. Tangential-Type Air Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Tank: Welded steel; ASME constructed and labeled for **125-psig** minimum working pressure and **240 deg F** maximum operating temperature.
3. Air Collector Tube: Perforated stainless steel, constructed to direct released air into expansion tank.
4. Tangential Inlet and Outlet Connections: Threaded for **NPS 2** and smaller; flanged connections for **NPS 2-1/2** and larger.
5. Blowdown Connection: Threaded.
6. Size: Match system flow capacity.

## 2.3 HYDRONIC PIPING SPECIALTIES

### A. Y-Pattern Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Armstrong Machine Works.
  - b. Hoffman Specialty ITT; Fluid Handling Div.
  - c. Metraflex Co.
  - d. Mueller
  - e. Spirax Sarco.
  - f. Trane Co.
  - g. Tyco-Grinnell.
  - h. Tour & Andersson; available through Victaulic Company.
  - i. Watts Regulator Co.
2. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
4. Strainer Screen: Stainless-steel, or perforated stainless-steel basket:
  - a. **20-mesh** strainer.
5. CWP Rating: **125 psig**.

### B. Basket Strainers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Crane Co.
  - b. Metraflex Co.

- c. Mueller
  - d. Spirax Sarco.
  - e. Tyco-Grinnell.
  - f. Tour & Andersson; available through Victaulic Company.
2. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
  3. End Connections: Threaded ends for **NPS 2** and smaller; flanged ends for **NPS 2-1/2** and larger.
  4. Strainer Screen: Perforated stainless-steel basket with 50 percent free area:
    - a. **40-mesh startup strainer.**
  5. CWP Rating: **125 psig.**

C. Spherical, Rubber, Flexible Connectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amber-Booth.
  - b. Mason Industries.
  - c. Metraflex Co.
  - d. Flex-Weld.
  - e. Proco.
  - f. Fugate.
  - g. Twin City Hose.
2. Body: Double-sphere fiber-reinforced EPDM rubber body.
3. End Connections: Steel flanges drilled to align with Classes 150 and 300 steel flanges.
4. Performance: Capable of misalignment.
5. CWP Rating: **150 psig.**
6. Maximum Operating Temperature: **250 deg F.**

D. Diverting Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - a. Amtrol, Inc.
  - b. Armstrong Pumps, Inc.
  - c. Bell & Gossett Domestic Pump.
  - d. Taco, Inc.
2. Body: Cast Iron or Wrought Copper
3. Ends: Threaded or Soldered
4. Flow Direction: Indicated on fitting.
5. CWP Rating: **125 psig.**
6. Maximum Operating Temperature: **250 deg F.**



## PART 3 - EXECUTION

### 3.1 VALVE APPLICATIONS

- A. Install shutoff-duty valves at each branch connection to supply mains and at supply connection to each piece of equipment.
- B. **Install calibrated-orifice**, balancing valves at each branch connection to return main.
- C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.
- D. Install check valves at each pump discharge and elsewhere as required to control flow direction.
- E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.
- F. Install pressure-reducing valves at make-up-water connection to regulate system fill pressure.

### 3.2 HYDRONIC SPECIALTIES INSTALLATION

- A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.
- B. Automatic air vents may cause damage to ceilings and other finished surfaces. Air vents aid in system filling. Air removal after initial startup is accomplished by air separator or boiler diptube. Manual air vents may be a better solution.
- C. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Install manual vents at heat-transfer coils and elsewhere as required for air venting.
- D. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
- E. Install in-line air separators in pump suction. Install drain valve on air separators **NPS 2** and larger.
- F. Install tangential air separator in pump suction. Install blowdown piping with **gate or** full-port ball valve; extend full size to nearest floor drain.
- G. Install expansion tanks above the air separator. Install tank fitting in tank bottom and charge tank. Use manual vent for initial fill to establish proper water level in tank.
  - 1. Install tank fittings that are shipped loose.
  - 2. Support tank from floor or structure above with sufficient strength to carry weight of tank, piping connections, fittings, plus tank full of water. Do not overload building components and structural members.

- H. Install expansion tanks on the floor. Vent and purge air from hydronic system, and ensure that tank is properly charged with air to suit system Project requirements.

END OF SECTION 23 2116

## SECTION 23 3001 - COMMON DUCT REQUIREMENTS

### PART 1 - PRODUCTS

#### 1.1 SUMMARY

A. Includes But Not Limited To:

1. General procedures and requirements for ductwork.
2. Repair leaks in ductwork, as identified by smoke test, at no additional cost to Owner.
3. Soundproofing procedures for duct penetrations of walls, ceilings, and floors in mechanical equipment rooms.

B. Related Sections:

1. Division 07: Quality of Acoustic Sealant.
2. Section 23 0500: Common Work Results for HVAC
3. Section 23 0593: Testing Adjusting and Balancing for HVAC.

#### 1.2 SUBMITTALS

A. Samples: Sealer and gauze proposed for sealing ductwork.

B. Quality Assurance / Control:

1. Manufacturer's installation manuals providing detailed instructions on assembly, joint sealing, and system pressure testing for leaks.
2. Specification data on sealer and gauze proposed for sealing ductwork.

#### 1.3 QUALITY ASSURANCE

A. Requirements: Construction details not specifically called out in Contract Documents shall conform to applicable requirements of SMACNA HVAC Duct Construction Standards.

B. Pre-Installation Conference: Schedule conference immediately before installation of ductwork.

## PART 2 - PRODUCTS

- 2.1 Finishes, Where Applicable: Colors as selected by Architect.
- 2.2 Duct Hangers:
  - A. One inch by **18 ga** galvanized steel straps or steel rods as shown on Drawings, and spaced not more than **96 inches** apart. Do not use wire hangers.
    - 1. Attaching screws at trusses shall be **2 inch** No. 10 round head wood screws. Nails not allowed.
    - 2. Attach threaded rod to steel joist with Grinnell Steel washer plate Fig. 60 - ph-1. Double nut connection.
- 2.3 Penetration Soundproofing Materials:
  - A. Insulation for Packing: Fiberglass.
  - B. Calking: Polysulphide.
  - C. Escutcheon Frame: **22 ga** galvanized iron **2 inches** wide.

## PART 3 - EXECUTION

- 3.1 INSTALLATION
  - A. During installation, protect open ends of ducts by covering with plastic sheet tied in place to prevent entrance of debris and dirt.
  - B. Make necessary allowances and provisions in installation of sheet metal ducts for structural conditions of building. Revisions in layout and configuration may be allowed, with prior written approval of Architect. Maintain required airflows in suggesting revisions.
  - C. Hangers And Supports:
    - 1. Install pair of hangers close to each transverse joint and elsewhere as required by spacing indicated in table on Drawings.
    - 2. Install upper ends of hanger securely to floor or roof construction above by method shown on Drawings.
    - 3. Attach strap hangers to ducts with cadmium-plated screws. Use of pop rivets or other means will not be accepted.
    - 4. Where hangers are secured to forms before concrete slabs are poured, cut off flush all nails, strap ends, and other projections after forms are removed.

5. Secure vertical ducts passing through floors by extending bracing angles to rest firmly on floors without loose blocking or shimming. Support vertical ducts, which do not pass through floors, by using bands bolted to walls, columns, etc. Size, spacing, and method of attachment to vertical ducts shall be same as specified for hanger bands on horizontal ducts.

D. Penetration Soundproofing

1. Pack space between ducts and structure full of fiberglass insulation of sufficient thickness to be wedged tight, allowing space for application of caulking.
2. Provide caulking at least **2 inches** thick between duct and structure on both ends of opening through structure.
3. Provide metal escutcheon on Equipment Room side. Secure escutcheon to wall.

3.2 CLEANING

- A. Clean interior of duct systems before final completion.

END OF SECTION 23 3001

## SECTION 23 3113 - METAL DUCTS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:

- 1. Single-wall rectangular ducts and fittings.
  - 2. Single-wall **round** ducts and fittings.
  - 3. Sheet metal materials.
  - 4. Duct liner.
  - 5. Sealants and gaskets.
  - 6. Hangers and supports.

- B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
  - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
  - 3. Section 230713 "Duct Insulation" for duct insulation and fire wrap.

#### 1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

#### 1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:
  - 1. Liners and adhesives.
  - 2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and **vibration isolation**.
13. Duct fabrication shall not begin until shop drawings have been submitted and reviewed by the mechanical engineer.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. **Design Calculations: Calculations for selecting hangers and supports.**

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including, but not limited to the following:
  - a. Lighting fixtures.
  - b. Air outlets and inlets.
  - c. Speakers.
  - d. Sprinklers.
  - e. Access panels.
  - f. Perimeter moldings.

- B. Field quality-control reports.

## 1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to [AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.] [AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.] [AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.]
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
  - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
  - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
  - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- D. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

## PART 2 - PRODUCTS

### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Duct dimensions shown on drawings are inside clear dimensions.
- E. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable



sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.2 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.
- B. Duct dimensions shown on drawings are inside clear dimensions.
- C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  - 1. Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.
  - 2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  - 3. Coat insulation with antimicrobial coating.
  - 4. Cover insulation with polyester film complying with UL 181, Class 1.
- G. Interstitial Insulation: Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
  - 1. Maximum Thermal Conductivity: **0.25 Btu x in./h x sq. ft. x deg F** at **75 deg F** mean temperature.
- H. **Inner Duct:** Minimum **0.028-inch** perforated galvanized sheet steel having **3/32-inch**-diameter perforations, with overall open area of 23 percent. Inner duct shall be solid sheet steel a minimum of 10 feet downstream of humidifiers or air washers.
- I. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- J. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.3 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Duct dimensions shown on drawings are inside clear dimensions.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 1. Transverse Joints in Ducts Larger Than **60 Inches** in Diameter: Flanged.
- D. Longitudinal Seams: Not allowed.
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

## 2.4 DOUBLE-WALL ROUND DUCTS AND FITTINGS

- A. Duct dimensions shown on drawings are inside clear dimensions.
- B. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
  - 1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
    - a. Transverse Joints in Ducts Larger Than **60 Inches** in Diameter: Flanged.
  - 2. Longitudinal Seams: Not allowed.

3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. **Inner Duct:** Minimum **0.028-inch** perforated galvanized sheet steel having **3/32-inch**-diameter perforations, with overall open area of 23 percent.
  1. Inner duct shall be solid sheet steel a minimum of 15 feet downstream of humidifiers and/or air washers.
- D. **Interstitial Insulation:** Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
  1. Maximum Thermal Conductivity: **0.27 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
  2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
  3. Coat insulation with antimicrobial coating.
  4. Cover insulation with polyester film complying with UL 181, Class 1.
- E. **Interstitial Insulation:** Flexible elastomeric duct liner complying with ASTM C 534, Type II for sheet materials, and with NFPA 90A or NFPA 90B.
  1. Maximum Thermal Conductivity: **0.25 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.

## 2.5 SHEET METAL MATERIALS

- A. **General Material Requirements:** Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. **Galvanized Sheet Steel:** Comply with ASTM A 653.
  1. Galvanized Coating Designation: **G90**.
  2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. **Reinforcement Shapes and Plates:** ASTM A 36, steel plates, shapes, and bars; black and galvanized.
  1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.
- D. **Tie Rods:** Galvanized steel, **1/4-inch** minimum diameter for lengths **36 inches** or less; **3/8-inch** minimum diameter for lengths longer than **36 inches**.

## 2.6 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. CertainTeed Corporation; Insulation Group.
    - b. Johns Manville.
    - c. Knauf Insulation.
    - d. Owens Corning.
  2. Maximum Thermal Conductivity:
    - a. Type I, Flexible: **0.27 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
    - b. Type II, Rigid: **0.23 Btu x in./h x sq. ft. x deg F at 75 deg F** mean temperature.
  3. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
  4. Water-Based Liner Adhesive:
    - a. Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
    - b. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Flexible Elastomeric Duct Liner: Preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
    - a. Aeroflex USA Inc.
    - b. Armacell LLC.
    - c. Rubatex International, LLC
  2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
  3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
    - a. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Insulation Pins and Washers:
1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, , length to suit depth of insulation indicated with integral **1-1/2-inch** galvanized carbon-steel washer.

- a. **0.135-inch**-diameter shank.
  2. Insulation-Retaining Washers: With beveled edge sized as required to hold insulation securely in place but not less than **1-1/2 inches** in diameter.
    - a. Self-locking washers formed from **0.016-inch-thick aluminum**.
- D. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
  3. Butt transverse joints without gaps, and coat joint with adhesive.
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
  6. Secure liner with mechanical fasteners **4 inches** from corners and at intervals not exceeding **12 inches** transversely; at **3 inches** from transverse joints and at intervals not exceeding **18 inches** longitudinally.
  7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
    - a. Fan discharges.
    - b. Intervals of lined duct preceding unlined duct.
  8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
    - a. Sheet Metal Inner Duct Perforations: **3/32-inch** diameter, with an overall open area of 23 percent.
  9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated build-outs (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

## 2.7 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: **4 inches**.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: **10-inch wg**, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: **Minus 40 to plus 200 deg F**.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: **10-inch wg**, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel, stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: **10-inch wg**, positive or negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.

5. Use: O.
  6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of **3 cfm/100 sq. ft. at 1-inch wg** and shall be rated for **10-inch wg** static-pressure class, positive or negative.
  2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
  3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

## 2.8 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
  2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
  3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and

calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install **round** ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of **2 inch**, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least **1-1/2 inches**.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. **Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines"** .

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.



- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
  - 2. Outdoor, Supply-Air Ducts: Seal Class A.
  - 3. **Outdoor, Exhaust Ducts: Seal Class A.**
  - 4. **Outdoor, Return-Air Ducts: Seal Class A.**
  - 5. **Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.**
  - 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than **2-Inch wg**: Seal Class A.
  - 7. **Unconditioned Space, Exhaust Ducts: Seal Class A.**
  - 8. **Unconditioned Space, Return-Air Ducts: Seal Class A.**
  - 9. **Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class A.**
  - 10. **Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.**
  - 11. **Conditioned Space, Exhaust Ducts: Seal Class A.**
  - 12. **Conditioned Space, Return-Air Ducts: Seal Class A.**

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.

3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than **4 inches** thick.
  4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than **4 inches** thick.
  5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," **Table 5-1**, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within **24 inches** of each elbow and within **48 inches** of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of **16 feet**.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with the requirements specified in Section 230548 "Vibration and Seismic Controls for HVAC."
1. Comply with **ASCE/SEI 7**.

### 3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

### 3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

### 3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:
  - a. Supply Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - b. Return Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - c. Exhaust Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
  - d. Outdoor Air Ducts with a Pressure Class of **2-Inch wg** or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than **50 percent** of total installed duct area for each designated pressure class.
3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give **seven** days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.
2. Any liner showing evidence that it has wet at any time shall be removed and replaced with new liner.
  - a. Disinfect affected sheet metal, and pins.
  - b. Install new liner per specifications
  - c. Seal friable edges and seams of repaired liner.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.9 DUCT CLEANING

A. Clean **new** duct system before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct.

- Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with **99.97 percent** collection efficiency for **0.3-micron**-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Fabricate ducts with galvanized sheet steel.
- B. Ductwork running in areas where there are no ceilings or when noted on the drawings shall be doubled wall duct and shall meet the requirements indicated below.
- C. Supply Ducts:
  - 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive **2-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. Minimum SMACNA Seal Class: **A.**
    - d. SMACNA Leakage Class for Rectangular: **16.**
    - e. SMACNA Leakage Class for Round: **8.**
  - 2. Ducts Connected to Constant-Volume Air-Handling Units:
    - a. Pressure Class: Positive **3-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **8.**
    - d. SMACNA Leakage Class for Round: **4.**
  - 3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive **6-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **4.**
    - d. SMACNA Leakage Class for Round: **2.**
  - 4. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive **4-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for **Rectangular**: **4.**
    - d. SMACNA Leakage Class for Round: **2.**
- D. Return Ducts:

1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative **2-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **16.**
    - d. SMACNA Leakage Class for Round: **8.**
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative **2-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **16.**
    - d. SMACNA Leakage Class for Round: **8**
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative **3-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **8.**
    - d. SMACNA Leakage Class for Round: **4.**
- E. Exhaust Ducts:
1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
    - a. Pressure Class: Negative **2-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **16.**
    - d. SMACNA Leakage Class for Round: **4.**
  2. Ducts Connected to Air-Handling Units:
    - a. Pressure Class: Positive or negative **3-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **8.**
    - d. SMACNA Leakage Class for Round: **4.**
  3. Ducts Connected to Variable-Air-Volume Air-Handling Units:
    - a. Pressure Class: Positive **6-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **4.**

- d. SMACNA Leakage Class for Round: **2.**
- 4. Ducts Connected to Type I (Grease) Commercial Kitchen Hoods: Comply with NFPA 96.
  - a. Exposed to View: 18 gauge Type 304, stainless-steel sheet, No. 4 finish.
  - b. Concealed: 16 gauge black steel.
  - c. Pressure Class: Positive or negative **3-inch wg.**
  - d. Welded seams and joints.
  - e. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
  - f. SMACNA Leakage Class: **2.**
  - g. A light test shall be performed for grease duct prior to concealing the duct.
- 5. Ducts Connected to Type II (Heat) Commercial Kitchen Hoods:
  - a. Type 304, stainless-steel sheet.
  - b. Exposed to View: No. 4 finish.**
  - c. Pressure Class: Positive or negative 3-inch wg.**
  - d. Concealed: No. 2D finish.
  - e. Welded seams and joints.
  - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
  - g. SMACNA Leakage Class: **2.**
- 6. Ducts Connected to Dishwasher and Low Temperature Vapor and Odor Hoods:
  - a. Type 304, stainless-steel sheet.
  - b. Exposed to View: No. 4 finish.**
  - c. Pressure Class: Positive or negative 3-inch wg.**
  - d. Concealed: No. 2D finish.
  - e. Welded seams and flanged joints with watertight EPDM gaskets.
  - f. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations, flanged joints class A.
  - g. SMACNA Leakage Class: **2.**
- 7. Branch Ducts Connected to Fans Exhausting Laboratory and Process (ASHRAE 62.1, Class 3 and 4) Air:
  - a. Type 304, stainless-steel sheet.
    - 1) 0.05-inch thick.
    - 2) Exposed to View: No. 4 finish.
    - 3) Concealed: No. 2B finish.
  - b. Pressure Class: Positive or negative **6-inch wg.**

- c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
      - d. SMACNA Leakage Class: **2**.
      - e. Main laboratory exhaust trunks to be galvanized steel with same pressure, seal and leakage class.
  - 8. Ducts Connected to Cage Wash Areas:
    - a. Type 316 .05-inch thick stainless-steel sheet.
      - 1) Exposed to View: No. 4 finish.
      - 2) Concealed: No. 2B finish.
    - b. Pressure Class: Positive or negative **6-inch wg**.
    - c. Minimum SMACNA Seal Class: Welded seams, joints, and penetrations.
    - d. SMACNA Leakage Class: **2**.
  - 9. Ducts Connected to radioactive fume hoods:
    - a. Type 316 .05-inch thick stainless-steel sheet.
      - 1) Exposed to View: No. 4 finish.
      - 2) Concealed: No. 2B finish.
    - b. Pressure Class: Positive or negative **6-inch wg**.
    - c. Minimum SMACNA Seal Class: A. Flanged and gasketed joints for future disassembly for decontamination.
    - d. SMACNA Leakage Class: **2**.
  - 10. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative **4-inch wg**.
    - b. Minimum SMACNA Seal Class: **A**.
    - c. SMACNA Leakage Class for Rectangular: **4** .
    - d. SMACNA Leakage Class for Round: **2** .
- F. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
- 1. Ducts Connected to Fan Coil Units, Furnaces, Heat Pumps, and Terminal Units:
    - a. Pressure Class: Positive or negative **2-inch wg**.
    - b. Minimum SMACNA Seal Class: **A**.
    - c. SMACNA Leakage Class for Rectangular: **16** .
    - d. SMACNA Leakage Class for Round and Flat Oval: **4**.



- a. Pressure Class: Positive or negative **3-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **8.**
    - d. SMACNA Leakage Class for Round: **4.**
  3. Ducts Connected to Equipment Not Listed Above:
    - a. Pressure Class: Positive or negative **3-inch wg.**
    - b. Minimum SMACNA Seal Class: **A.**
    - c. SMACNA Leakage Class for Rectangular: **8.**
    - d. SMACNA Leakage Class for Round: **4.**
- G. Intermediate Reinforcement:
  1. Galvanized-Steel Ducts: **Galvanized steel.**
  2. PVC-Coated Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: **Match duct material.**
  3. Stainless-Steel Ducts:
    - a. Exposed to Airstream: Match duct material.
    - b. Not Exposed to Airstream: **Match duct material.**
  4. Aluminum Ducts: **Aluminum.**
- H. Duct Liner Restrictions:
  1. **Duct Liner exposed to air movement shall not be used on medium pressure ductwork (2000 to 4000 FPM velocity). See section 230713 "Duct Insulation" for insulation requirements.**
  2. **Duct Liner exposed to air movement shall not be used on high pressure ductwork (Greater than 4000 FPM velocity). See section 230713 "Duct Insulation" for insulation requirements.**
  3. **All duct liner shall meet all of the requirements found in 2012 IECC**
- I. Liner: (Ductwork located in Unconditioned space)
  1. Low Pressure Supply Air Ducts (Less than 2000 FPM velocity): **Fibrous glass, Type I, 1-1/2 inch** thick with a minimum R value of 6.0 for ducts in unconditioned spaces.
  2. Supply Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1-1/2 inch** thick for ducts in unconditioned spaces.

3. Return Air Ducts: **Fibrous glass, Type I, 1-1/2 inch** thick with a minimum R value of 6.0 for ducts in unconditioned spaces.
  4. Return Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick for ducts in conditioned spaces.
  5. Exhaust Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick.
  6. Supply Fan Plenums: **Fibrous glass, Type I, 1-1/2 inch** thick with a minimum R value of 6.0.
  7. Return- and Exhaust-Fan Plenums: **Fibrous glass, Type II, 1-1/2 inch** thick with a minimum R value of 6.0.
  8. Transfer Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick. **[1-1/2 inches] [2 inches]**.
- J. Liner: (Ductwork located Interior to building Insulated Envelope)
1. Low Pressure Supply Air Ducts (Less than 2000 FPM velocity): **Fibrous glass, Type I, 1 inch** thick with a minimum R value of 4.0 for ducts in unconditioned spaces.
  2. Supply Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick for ducts in conditioned spaces.
  3. Return Air Ducts: **Fibrous glass, Type I, 1 inch** thick with a minimum R value of 4.0 for ducts in unconditioned spaces.
  4. Return Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick for ducts in conditioned spaces.
  5. Exhaust Air Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick.
  6. Supply Fan Plenums: **Fibrous glass, Type I, 1 inch** thick with a minimum R value of 4.0.
  7. Return- and Exhaust-Fan Plenums: **Fibrous glass, Type II, 1 inch** thick with a minimum R value of 4.0.
  8. Transfer Ducts: **Fibrous glass, Type I [or flexible elastomeric] [Natural fiber], 1 inch** thick. **[1-1/2 inches] [2 inches]**.
- K. Double-Wall Duct Interstitial Insulation:
1. Supply Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.
  2. Return Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.
  3. Exhaust Air Ducts: **1-1/2 inch** thick with a minimum R value of 6.0.

L. Exterior Ductwork Liner Insulation:

1. Supply Air Ducts: **3 inch** thick with a minimum R value of 12.0.
2. Return Air Ducts: **3 inch** thick with a minimum R value of 12.0.
3. Exhaust Air Ducts: **3 inch** thick with a minimum R value of 12.0.

M. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
  - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
  - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
  - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
2. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
  - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
    - 1) Velocity **1000 fpm** or Lower: 1.0 radius-to-diameter ratio and three segments for 90-degree elbow.
    - 2) Velocity **1000 to 1500 fpm**: 1.5 radius-to-diameter ratio and four segments for 90-degree elbow.
    - 3) Velocity **1500 fpm** or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
    - 4) Radius-to Diameter Ratio: 1.5.
  - b. Round Elbows, **12 Inches** and Smaller in Diameter: Stamped or pleated.
  - c. Round Elbows, **14 Inches** and Larger in Diameter: Welded.

N. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
  - a. Rectangular Main to Rectangular Branch: 45-degree entry high efficiency take-off.
  - b. Rectangular Main to Round Branch: 45-degree entry high efficiency take-off.
2. **Round:**

- a. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
- b. Velocity **1000 to 1500 fpm**: **45-degree entry high efficiency tap**.
- c. Velocity **1500 fpm** or Higher: 45-degree lateral.

END OF SECTION 23 3113

## SECTION 23 3300 – AIR DUCT ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This Section includes the following:

1. Backdraft dampers.
2. Manual-volume dampers.
3. Fire and smoke dampers.
4. Smoke dampers
5. Fire dampers
6. Turning vanes.
7. Duct-mounted access doors and panels.
8. Flexible ducts.
9. Flexible connectors.
10. Duct accessory hardware.
11. Concealed damper regulators.
12. Remote damper adjustment

- B. Related Sections include the following:

1. Division 8 Section "Access Doors" for wall- and ceiling-mounted access doors and panels.
2. Division 23 Section "Air Terminals" for constant-volume and variable-air-volume control boxes, and reheat boxes.
3. Division 23 Section "Diffusers, Registers, and Grilles."
4. Division 26 Section "Fire Alarm Systems" for duct-mounted fire and smoke detectors.

- C. This division shall demonstrate that all Fire dampers and fire smoke dampers can be maintained and serviced and are operating correctly.

#### 1.3 SUBMITTALS

- A. Product Data: For the following:

1. Backdraft dampers.
2. Manual-volume dampers.

3. Fire and smoke dampers.
  4. Duct-mounted access doors and panels.
  5. Flexible ducts.
  6. Concealed damper regulators.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
1. Special fittings and manual- and automatic-volume-damper installations.
  2. Fire- and smoke-damper installations, including sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

#### 1.4 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
  2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

#### 1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.
- D. Extruded Aluminum: ASTM B 221, Alloy 6063, Temper T6.

- E. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## 2.2 BACKDRAFT DAMPERS

- A. Description: Suitable for horizontal or vertical installations.
- B. Frame: 0.063-inch- thick extruded aluminum, with mounting flange.
- C. Blades: 0.050-inch- thick aluminum sheet.
- D. Blade Seals: Neoprene.
- E. Blade Axles: Nonferrous.
- F. Tie Bars and Brackets: Aluminum.
- G. Return: Spring with adjustable tension adjustable counter balance.

## 2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  - 1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- B. Volume Dampers: Dampers smaller than 4 square feet of face area. Multiple- or single-blade, opposed-blade design as indicated, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
  - 1. Galvanized Steel Frames: Hat-shaped, 16 gauge, Galvanized steel channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
  - 2. Galvanized Steel Blades: Single skin 16 gauge galvanized steel.
  - 3. Blade Axles: Nonferrous.
  - 4. Bearings: Molder synthetic sleeve type.
- C. Jackshaft: 1-inch- diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.
- E. Each volume damper concealed above an inaccessible ceiling, etc., shall be provided with a shaft extended through the ceiling, to which shall be attached a chrome-plated or painted Ventlock No. 666 concealed damper regulator. No. 680 Ventlock miter gears shall be used where necessary.

## 2.4 COMBINATION FIRE-SMOKE DAMPERS

- A. General: Labeled to UL 555S and meeting the code requirements. Combination fire and smoke dampers shall be labeled for one-and-one-half-hour rating to UL 555 for rating assemblies less than 3 hours and three hours for rating assemblies 3 hours or more.
- B. Leakage Rate: Class 1 with less than 8 cfm square foot leakage at 4" w.g. static pressure.
- C. Pressure Rating: Fully operational will velocities to 4000 FPM and pressures in excess of 4" w.g.
- D. Fire Stat: Remotely resettable damper position with switches for remote indication. High Temperature limit returns damper to protection mode when temperature reaches operational limit of damper/actuator assembly.
- E. Frame and Blades: 0.064-inch- thick, galvanized, sheet steel, blades are to be Airfoil.
- F. Mounting Sleeve: Factory-installed, 0.052-inch- thick, unless otherwise indicated, galvanized, sheet steel; length to suit wall or floor application.
- G. Damper Motors: Locate outside air stream unless otherwise indicated. Provide for two-position action.
  1. Electric of voltage to match fire alarm system (120V). UL listed as part of damper assembly.
  2. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
- H. Provide smoke dampers with two contactor indicators, one for the open position & one for the closed position.
- I. Temperature ratings are to be 250 deg F. Minimum.
- J. Operational Ratings 2000 fpm at 4 in. wg.



- K. Provide a factory mounted single point smoke detector with the Damper. UL Listed S1383. This is not required if a Fire Alarm is provided by division 26.
- L. Provide a testable/resettable switch with each damper.

## 2.5 SMOKE DAMPERS

### A. Ratings:

- 1. Smoke Rating: Leakage Class II Smoke Damper in accordance with UL555S. A Class II smoke damper leaks no more than 20 cubic feet per minute (.57 m<sup>3</sup>/min) at 4 in. wg. (1 kPa) differential pressure.
- 2. Elevated Temperature Rating: 250°F.
- 3. Air Flow Rating: 2000 fpm.
- 4. Pressure Rating: 4 in. wg.

### B. Construction:

- 1. Frame: 5 inches x minimum 16 gage (127 x minimum 1.6 mm) roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gage (2.3 mm) U-channel type frame.
- 2. Blades:
  - a. Style: True airfoil-shaped, single piece, double skin.
  - b. Action: Opposed.
  - c. Orientation: Horizontal.
  - d. Material: Minimum 14 gage (2.0 mm) equivalent thickness, galvanized steel.
  - e. Width: Maximum 6 inches (152 mm).
- 3. Bearings: Self-lubricating stainless steel sleeve, turning in extruded hole in frame.
- 4. Seals:
  - a. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450°F (232°C). Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
  - b. Jamb: Stainless steel, flexible metal compression type.
- 5. Linkage: Concealed in frame.
- 6. Axles: Minimum ½ inch (13) diameter plated steel, hex-shaped, mechanically attached to blade.
- 7. Mounting: Vertical and/or Horizontal.
- 8. Actuator: Type: Electric 120 V, 60 Hz, two-position, fail close. Mounting: External..
- 9. Finish: Mill galvanized.
- 10. Indicator or Auxiliary Switch Packages: SP 100 Switch Package – Two position indicator switches linked directly to damper blade to remotely indicate damper blade position.
- 11. DSD – Duct Smoke Detector: Factory Mounted. Type: Photoelectronic.
- 12. Factory Sleeve: Minimum 20 gage (1.0 mm) thickness. Minimum 12 inches (432 mm) long.

## 2.6 FIRE DAMPERS

### A. Curtain type fire dampers.

1. Ratings Fire Resistance: 1½ hours in accordance with UL 555.
2. Dynamic Closure Rating: Dampers shall be classified for dynamic closure to 2000 fpm and 4 inches w.g. (1 kPa) static pressure.

### B. Construction:

1. Integral Sleeve Frame: Minimum 20 gauge roll formed galvanized steel.
2. Blades:
  - a. Style: Curtain type, out of airstream.
  - b. Action: Spring or gravity closure upon fusible link release.
  - c. Orientation: Horizontal.
  - d. Material: Minimum 24 gage (0.6 mm) roll formed galvanized steel.
3. Closure Springs: Type 301 stainless steel, constant force type, if required.
4. Temperature Release Device: 212 degrees F (100 degrees C) fusible link.
5. Mounting: Vertical and/or Horizontal. Duct Transition Connection, Damper Style: Blades out of air stream, high free area.
6. Finish: Mill galvanized.
7. Indicator Switches: Microswitch.
8. Mounting Angles: FAST, 1-1/2 x 1-1/2 inches (38 x 38 mm). Provide steel mullions for dampers in oversized masonry walls. Provide duct breakaway connection in all duct/damper connections.

## 2.7 TURNING VANES

- A. Fabricate single blade vanes to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
- B. Acoustic Turning Vanes: Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

## 2.8 DUCT-MOUNTED ACCESS DOORS AND PANELS

- A. General: Fabricate doors and panels airtight and suitable for duct pressure class.
- B. Frame: Galvanized, sheet steel, with bend-over tabs and foam gaskets.
- C. Door: Double-wall, galvanized, sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

## 2.9 FLEXIBLE CONNECTORS

- A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Standard Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.
- C. Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
  - 1. Minimum Weight: 26 oz./sq. yd..
  - 2. Tensile Strength: 530 lbf/inch in the warp, and 440 lbf/inch in the filling.

## 2.10 FLEXIBLE DUCTS

- A. General: Comply with UL 181, Class 1.
- B. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-1/2-inch- thick, glass-fiber insulation around a continuous inner liner.
  - 1. Reinforcement: Steel-wire helix encapsulated in inner liner.
  - 2. Outer Jacket: Glass-reinforced, silver Mylar with a continuous hanging tab, integral fibrous-glass tape, and nylon hanging cord.
  - 3. Inner Liner: Polyethylene film.
- C. Pressure Rating: 6-inch wg positive, 1/2-inch wg negative.
- D. Flexible duct connections from the main trunk ducts to diffuser boots shall be furnished and installed as shown on the drawings. Flexible ducts shall have compression fittings on both ends. Flexible ducts shall connect to trunk duct with high efficiency takeoffs. A balance damper with locking quadrant will be provided downstream of take-off from trunk duct.
- E. Ducts shall conform to the requirements for Class I connectors when tested in accordance with "Standard for Factory Made Air Ducts Materials and Air Duct Connectors" (UL 181). Ducts shall also pass the 15 minute U.L. flame penetration test as specified in the UL 181 Standard.
- F. Flexible ducts shall not extend more than 5'-0". Flexible ductwork shall be run in straight lengths. Flexible ductwork is not allowed to bend 90 degrees. If a bend is needed use sheet-metal hard elbows.

## 2.11 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 length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.
- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

## 2.12 REMOTE DAMPER OPERATOR

1. Use one of the two options below:

- A. Damper controller and cable shall be concealed above the ceiling or in the walls. Cable to consist of Bowden cable .054" stainless steel control wire encapsulated in 1/16" flexible galvanized spiral wire sheath. Control kit shall consist of 2-5/8" diameter die cast aluminum housing with 3" diameter zinc plated [polished chrome is optional] cover, and 14 gauge steel rack and pinion gear drive converting rotary motion to push-pull motion. Control shaft shall be D-style flatted 1/4" diameter with 265 degree rotation providing graduations for positive locking and control, and 1-1/2" linear travel capability. Control kit is designed to be imbedded in the ceiling flush with the finished surface or flush with the wall. Control kit shall be manually operated using Young Regulator Model 030-12 wrench. Control kit shall be Young Regulator Model 270-301 or prior approved equal.
- B. Damper controller. Provide a remote control operated zone control damper. Damper shall be a butterfly type, consisting of a circular blade, fastened to a continuous 3/8" mild steel square shaft. Inside frame surface shall be clean and smooth with no blade stops or similarly inward projections that increase pressure drop. Frame shall be 20 gage minimum G60 galvanized steel and include full circumference rolled stiffener. The blade shall be of the same material as the frame. The bearing shall be molded lexan GE141 and shall be formed to shape the axle. A 9 volt DC operated damper motor shall be factory installed and commissioned prior to shipping. The actuator shall include a factory wired RJ11 connector. Damper shall be installed with plenum rated RJ11 cable terminating at the damper motor connector on one end and the wall box or diffuser on the other end. The unit shall be a Ruskin Model ZPD25.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and NAIMA's "Fibrous Glass Duct Construction Standards" for fibrous-glass ducts.
- B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Provide test holes at fan inlet and outlet and elsewhere as indicated.
- D. Install fire and smoke dampers according to manufacturer's UL-approved written instructions.
  - 1. Install fusible links in fire dampers.
- E. Install duct access panels for access to both sides of duct coils. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.
  - 1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
  - 2. Install access panels on side of duct where adequate clearance is available.
- F. Label access doors according to Division 26 Section "Identification for Piping and Equipment."
- G. Where flexible duct is indicated, use insulated flexible duct for supply air return and exhaust air. Flexible ductwork shall only be used as indicated on the drawings and shall not exceed 6 feet. Hard turns, offsets, or kinks will not be allowed. Provide support every three feet.
- H. Use the remote damper operator when they are called out on the drawings or when the damper cannot be easily accessed.

#### 3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION 23 3300

## SECTION 23 3600 - AIR TERMINAL UNITS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. Section Includes:
  - 1. Shutoff, single-duct air terminal units.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of the following products, including rated capacities, furnished specialties, sound-power ratings, and accessories.
  - 1. Air terminal units.
  - 2. Liners and adhesives.
  - 3. Sealants and gaskets.
  - 4. Seismic-restraint devices.
- B. Shop Drawings: For air terminal units. Include plans, elevations, sections, details, and attachments to other work.
  - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Wiring Diagrams:
  - a. For power, signal, and control wiring.
  - b. Differentiate between manufacturer-installed and field-installed wiring.
3. **Hangers and supports**, including methods for duct and building attachment and vibration isolation.

C. Delegated-Design Submittal:

1. Materials, fabrication, assembly, and spacing of hangers and supports.
2. **Design Calculations:** Calculations, **including analysis data signed and sealed by the qualified professional engineer responsible for their preparation** for selecting hangers and supports.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  1. Ceiling suspension assembly members.
  2. Size and location of initial access modules for acoustic tile.
  3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
- B. Field quality-control reports.

1.5 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Air terminal units shall withstand the effects of earthquake motions determined according to **SEI/ASCE 7**.
  - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

#### 1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
  - 1. Instructions for resetting minimum and maximum air volumes.
  - 2. Instructions for adjusting software set points.

#### 1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
  - 1. Fan-Powered-Unit Filters: Furnish **one** spare filter for each filter installed.

#### 1.8 QUALITY ASSURANCE

- A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
- B. Product Options: Drawings and schedules indicate requirements of air terminals and are based on specific systems indicated. Other manufacturers' systems with equal performance characteristics may be considered. Refer to Division 1 Section "Substitutions."
- C. Listing and Labeling: Provide electrically operated air terminals specified in this Section that are listed and labeled.
  - 1. The Terms "Listed" and "Labeled": As defined in NFPA 70, Article 100.
- D. NFPA Compliance: Install air terminals according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."
- E. Comply with NFPA 70 for electrical components and installation.



## PART 2 - PRODUCTS

### 2.1 PERFORMANCE REQUIREMENTS

- A. **Structural Performance:** Hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" .

### 2.2 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Anemostat Products; a Mestek Company.
  - 2. Carnes.
  - 3. Environmental Technologies, Inc.
  - 4. Krueger.
  - 5. METALAIRE, Inc.
  - 6. Nailor Industries Inc.
  - 7. Price Industries.
  - 8. Titus.
  - 9. Trox USA Inc.; a subsidiary of the TROX GROUP.
  - 10. Tuttle & Bailey.
  - 11. Warren Technology.
- B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.
- C. **Casing: 0.034-inch steel, single wall.**

1. **Casing Lining:** Adhesive attached, **coated, fibrous-glass duct liner** complying with ASTM C 1071, and having a maximum flame-spread index of 25 and a maximum smoke-developed index of 50, for both insulation and adhesive, when tested according to ASTM E 84.
    - a. Lining thickness:
      - 1) **1/2-inch-**
    - b. Cover liner with nonporous foil.
  2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
  3. Air Outlet: S-slip and drive connections.
  4. Air Outlet: S-slip and drive connections **size matching inlet size.**
  5. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
- D. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
1. Maximum Damper Leakage:
    - a. ARI 880 rated, **3** percent of nominal airflow at **3-inch wg** inlet static pressure.
  2. Damper Position:
    - a. Normally **open.**
- E. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than **0.1 inch**, and rated for a minimum working pressure of **200 psig** and a maximum entering-water temperature of **220 deg F**. Include manual air vent and drain valve.
- L. Direct Digital Controls: Bidirectional damper operators and microprocessor-based controller and room sensor. Control devices shall be compatible with temperature controls specified in Section 230900 "Instrumentation and Control for HVAC" and shall have the following features:
1. **Damper Actuator: 24 V, powered closed, spring return open.**
  2. Terminal Unit Controller: Pressure-independent, variable-air-volume controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
    - a. Occupied and unoccupied operating mode.
    - b. Remote reset of airflow or temperature set points.
    - c. Adjusting and monitoring with portable terminal.
    - d. Communication with temperature-control system specified in Section 230900 "Instrumentation and Control for HVAC."
  3. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

F. Control Sequence:

1. Suitable for operation with duct pressures between **0.25- and 3.0-inch wg** inlet static pressure.
2. System-powered, wall-mounted thermostat.

2.4 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. **Steel Cables: Galvanized steel complying with ASTM A 603.**
- D. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- E. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- F. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.5 SOURCE QUALITY CONTROL

- A. Factory Tests: Test assembled air terminal units according to ARI 880.
  1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, and ARI certification seal.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

- B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.
- C. Install wall-mounted thermostats.
- D. Install discharge air temperature sensors at the outlet of each Air Terminal Unit.
- E. Connect ductwork to air terminals according to Division 23 ductwork Sections.
- F. Comply with SEI/ASCE 7 and with requirements for seismic-restraint devices in Section 230548 "Vibration and Seismic Controls for HVAC."
- G. For Diffuser Type Air Terminal Units, provide and install all necessary control wiring and control voltage transformer. See drawings AND schedules for additional information.

### 3.2 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
  - 1. Where practical, install concrete inserts before placing concrete.
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes and for slabs more than **4 inches** thick.
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than **4 inches** thick.
  - 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hangers Exposed to View: Threaded rod and angle or channel supports.
- D. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

### 3.3 CONNECTIONS

- A. Install piping adjacent to air terminal unit to allow service and maintenance.
- B. Hot-Water Piping: In addition to requirements in Section 232113 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.
- C. Connect ducts to air terminal units according to **Section 233113 "Metal Ducts.**
- D. Electrically ground all equipment:
  - 1. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. Where manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

### 3.4 IDENTIFICATION

- A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

### 3.5 FIELD QUALITY CONTROL

- A. **Testing Agency:** **Owner will engage** a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- C. 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.

D. Tests and Inspections:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

E. Air terminal unit will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Cleaning:

1. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris, and repair damaged finishes.

### 3.6 STARTUP SERVICE

A. **Engage a factory-authorized service representative to perform** startup service.

1. Complete installation and startup checks according to:
  - a. Manufacturer's written instructions.
  - b. Construction documents.
2. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.

### 3.7 DEMONSTRATION

A. **Engage a factory-authorized service representative to train** Owner's maintenance personnel to adjust, operate, and maintain air terminal units:

1. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.

2. Review data in the maintenance manuals. Refer to Division 1 Section "Contract Closeout."
3. Review data in the maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data."
4. Schedule training with Owner, through Architect, with at least 7 days' advance notice.

END OF SECTION 23 3600

## SECTION 23 3713 - DIFFUSERS, REGISTERS, AND GRILLES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

#### 1.2 SUMMARY

- A. This section includes ceiling- and wall-mounted diffusers, registers, and grilles.
- B. Related Sections:
  - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.
  - 2. Section 230594 "General Testing, Adjusting and Balancing" for balancing diffusers, registers, and grilles.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
  - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

#### 1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
  - 1. Ceiling suspension assembly members.
  - 2. Method of attaching hangers to building structure.
  - 3. Size and location of initial access modules for acoustical tile.
  - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
  - 5. Duct access panels.
- B. Source quality-control reports.



## 1.5 QUALITY ASSURANCE

- A. Product Options: Drawings and schedules indicate specific requirements of diffusers, registers, and grilles and are based on the specific requirements of the systems indicated.
- B. NFPA Compliance: Install diffusers, registers, and grilles according to NFPA 90A, "Standard for the Installation of Air-Conditioning and Ventilating Systems."

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Air Factors
  - 2. Carnes.
  - 3. Kruegar.
  - 4. METALAIRE, Inc.
  - 5. Nailor Industries Inc.
  - 6. Price Industries.
  - 7. Titus.
  - 8. Tuttle & Bailey.
  - 9. Air Concepts.
  - 10. Trox.

### 2.2 REGISTERS, GRILLES, & DIFFUSERS

- A. General: The frames for all registers, grilles, and diffusers shall match type of ceiling where they are to be installed. Special frames shall be provided for narrow T-bar ceilings. Refer to reflected ceiling plan and other specification divisions for ceiling type. See drawings AND schedules for additional information.

### 2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions, coordination drawings, original design, and referenced standards.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

#### 3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

#### 3.4 CLEANING

- A. After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 23 3713

SECTION 26 0500 - ELECTRICAL GENERAL PROVISIONS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full.

1.2 DESCRIPTION OF WORK:

- A. The extent of electrical work is indicated on drawings and/or specified in Divisions 26, 27 and 28 sections of the specification. Provide all labor, materials, equipment, supervision and service necessary for a complete electrical system. Work includes, but is not necessarily limited to, the following items.

<u>ITEM</u>	<u>SECTION</u>
1. Electrical General Provisions	26 0500
2. Electrical Submittals O & M Manuals and Spare Parts	26 0502
3. Electrical Connections for Equipment	26 0507
4. Conductors and Cables	26 0519
5. Grounding	26 0526
6. Supporting Devices	26 0529
7. Conduit Raceway	26 0532
8. Electrical Boxes and Fittings	26 0533
9. Electrical Identification	26 0553
10. Lighting Control Equipment	26 0943
11. Wiring Devices	26 2726
12. Overcurrent Protective Devices	26 2815
13. Demolition	26 4119
14. Interior and Exterior Building Lighting	26 5100
15. CSD – Network Cabling Global Specification	27 1500
16. Audiovisual Systems	27 4100
17. Audiovisual System Checklists	27 4101
18. Intercommunication Systems	27 5123
19. Fire Alarm and Detection System	28 3111

- B. Use of standard industry symbols together with the special symbols, notes, and instructions indicated on the drawings describe the work, materials, apparatus and systems required as a portion of this work.
- C. Visit the site during the bidding period to determine existing conditions affecting electrical and other work. All costs arising from site conditions and/or preparation shall

be included in the base bid. No additional charges will be allowed due to inadequate site inspection.

1.3 DEFINITION OF TERMS:

A. The following terms used in Divisions 26, 27 and 28 documents are defined as follows:

1. "Provide": Means furnish, install and connect, unless otherwise indicated.
2. "Furnish": Means purchase and deliver to project site.
3. "Install": Means to physically install the items in-place.
4. "Connect": Means make final electrical connections for a complete operating piece of equipment.

1.4 RELATED SECTIONS:

A. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

B. General and Supplementary Conditions: Drawings and general provisions of contract and Division 1 of the Specifications, apply to all Division 26, 27 and 28 sections.

C. Earthwork:

1. Provide trenching, backfilling, boring and soil compaction as required for the installation of underground conduit, buried cable, in-grade pull boxes, manholes, lighting pole foundations, etc. See Division 31, Sitework, and other portions of Divisions 26, 27 and 28, for material and installation requirements.

D. Miscellaneous Metal Work:

1. Provide fittings, brackets, backing, supports, rods, welding and pipe as required for support and bracing of raceways, lighting fixtures, panelboards, distribution boards, switchboards, motor controls centers, etc. See Division 5, Metals for material and installation requirements.

E. Miscellaneous Lumber and Framing Work:

1. Provide wood grounds, nailers, blocking, fasteners, and anchorage for support of electrical materials and equipment. See Division 6, Rough Carpentry for material and installation requirements.

F. Moisture Protection:

1. Provide membrane clamps, sheet metal flashing, counter flashing, caulking and sealants as required for waterproofing of conduit penetrations and sealing penetrations in or through fire walls, floors and ceiling slabs and foundation walls. All penetrations through vapor barriers at slabs on grade shall be taped and made vapor tight. See Division 7, Thermal and Moisture Protection for material and installation requirements.

G. Access panels and doors:

1. Provide in walls, ceiling, and floors for access to electrical devices and equipment. See Division 8, Doors and Windows for material and installation requirements.

H. Painting:

1. Provide surface preparation, priming and finish coating as required for electrical cabinets, exposed conduit, pull and junction boxes, poles, surface metal raceways, etc. See Division 9, Finishes for material and installation requirements.

1.5 WORK FURNISHED AND INSTALLED UNDER ANOTHER SECTION REQUIRING CONNECTIONS UNDER THIS SECTION:

- A. Provide electrical service, make requisite connections and perform operational test. Items furnished and installed under other sections and connected under this section, include but are not limited to the following:
  1. Electric motors.
  2. Package mechanical equipment: fans, fan coil units, pumps, boilers, duplex compressors, etc.
  3. Motorized dampers.
  4. Fire and smoke dampers
  5. Duct mounted smoke detectors.
  6. Electric hardware.
  7. Systems/Open Office Furniture.
  8. Electric Chain Hoist.
  9. Solatubes.

1.6 ITEMS FURNISHED UNDER ANOTHER DIVISION, BUT INSTALLED AND CONNECTED UNDER THIS DIVISION:

- A. Items furnished under other Divisions, but turned over to Division 26 for installation and final connection include, but are not necessarily limited to, the following:
  1. Wall mounted control stations for motorized roll-up doors/grills.
  2. Wall mounted control stations for motorized projection screens.
  3. Wall mounted control stations for electric chain hoist repair lift.

1.7 INTERPRETATION OF DRAWINGS AND SPECIFICATIONS:

- A. Before bidding, Contractor shall familiarize himself with the drawings, specifications and project site. Submit requests for clarification to Architect/Engineer in writing prior to issuance of final addendum. After signing the contract, the Contractor shall meet the intent, purpose, and function of the Contract Documents. Any costs of materials, labor and equipment arising therefrom, to make each system complete and operable, is the responsibility of the Contractor.

1.8 REQUESTS FOR INFORMATION (RFIs):

- A. Contractor shall review all Contract Documents thoroughly before submitting an RFI to avoid unnecessary questions and ensure the question has not already been addressed within the existing Contract Documents.
- B. RFIs should be used to seek clarification on issues or areas of confusion that cannot be

resolved through a review of the Contract Documents.

- C. Each RFI shall contain the following:
  - 1. Description of the Issue/Question: Clearly detail the issue or confusion, referencing the related Contract Document drawings and/or specifications.
  - 2. Relevant Documents: Attach any necessary supporting documents that could aid in understanding the RFI.
  - 3. Proposed Solution: Suggest a possible resolution to the problem or confusion.
- D. Non-Compliant RFIs
  - 1. Frivolous or incomplete RFIs will not be accepted. RFIs that do not follow the guidelines set forth in this section, or are deemed unnecessary, may be returned without response at the discretion of the Engineer.

#### 1.9 QUALITY ASSURANCE:

- A. Reference to codes, standards, specifications and recommendations of technical societies, trade organizations and governmental agencies refers to the latest edition of such publications adopted and published prior to submittal of the bid proposed, unless noted otherwise herein. Such codes or standards are considered a part of this specification as though fully repeated herein.
- B. When codes, standards, regulations, etc. allow work of lesser quality or extent than is specified under this Division, nothing in said codes shall be construed or inferred as reducing the quality, requirements or extent of the Drawings and Specifications. Perform work in accordance with applicable requirements of all governing codes, rules and regulations including the following minimum standards, whether statutory or not:
  - 1. National Electric Code (NEC).
  - 2. International Building Code (IBC).
  - 3. International Fire Code (IFC).
  - 4. International Mechanical Code (IMC).
- C. Standards: Comply with the following standards where applicable for equipment and materials specified under this Division.
  - 1. UL Underwriters' Laboratories
  - 2. ASTM American Society for Testing Materials
  - 3. CBN Certified Ballast Manufacturers
  - 4. IPCEA Insulated Power Cable Engineers Association
  - 5. NEMA National Electrical Manufacturer's Association
  - 6. ANSI American National Standards Institute
  - 7. ETL Electrical Testing Laboratories
- D. All electrical apparatus furnished under this Section shall conform to (NEMA) standards and the NEC and bear the Underwriters' Laboratories (UL) label where such label is applicable.
- E. Comply with requirements of State and Local Ordinances. If a conflict occurs between these requirements and the Contract Documents, the most stringent requirements shall govern. The Contractor accepts this responsibility upon submitting his bid, and no extra

charge will be allowed after the contract is awarded. This shall not be construed as relieving the Contractor from complying with any requirements of the Contract Documents that may be in excess of the aforementioned requirements, and not contrary to same.

- F. Obtain all permits, inspections, etc. required by authority having jurisdiction. Include all fees in bid. Furnish a certificate of approval to the Owner's Representative from the Inspection Authority at completion of the work.
- G. Employ only qualified craftsmen with at least three years of experience. Workmanship shall be neat, have a good mechanical appearance and conform to best electrical construction practices. Provide a competent superintendent to direct the work at all times. Any person found incompetent shall be discharged from the project and replaced by satisfactory personnel.
- H. Contractor shall have a current state contracting license applicable to type of work to be performed under this contract.
- I. Required Pre-Electrical Construction Meeting with Electrical Engineer: Electrical contractor/representative will be required to attend a pre-electrical construction meeting (approximately 30-60 minutes) with engineering representative in the electrical engineers office prior to electrical construction commencement. This meeting will address any questions on the part of the contractor and the expectations of the Engineer with regard to specifications, plans and site visits for both rough and finish electrical work.
- J. AV contractor shall attend the electrical pre-construction meeting per specification 26 0500.
  - 1. Electrical Contractor shall inform the AV Installer of pre-construction meeting. AV Contractor shall be in attendance at the pre-construction meeting.

#### 1.10 CONSTRUCTION CHANGE ORDER PROPOSALS

- A. In the event that a submission of a change order is issued by the contractor, the following information will be required to be submitted by the contractor, prior to any consideration by the owner/architect.
  - a. Where project manager or project engineer work is required, the labor cost shall not exceed 2% of the electrical portion of the change order.
  - b. All equipment, including conduit and wire, shall be itemized, identifying unit costs and quantities of equipment. Distributor quotes shall accompany all change order requests. The distributor quotes shall include costs for all equipment including conduit and wire. Lot pricing for equipment is not acceptable.
  - c. The general contractor shall review and confirm that the quantity and costs of materials submitted appear reasonable for the scope proposed.
  - d. Labor units shall not exceed base NECA #1 standards. No adjustment factors shall be approved.
  - e. Any research and labeling time, shall be the responsibility of the electrical contractor and shall not be included in the change order request.

- f. Any costs associated with the purchase of tools or transportation shall be fully itemized for review by architect/owner.
- g. Overtime rates shall only be approved where additional manpower cannot achieve the same result.
- h. Change order form shall follow the following format:
  - i. PCO number
  - ii. Detailed description of work being performed
  - iii. Location on project where work is performed
  - iv. Chosen NECA column
  - v. Identified material:
    - 1. QTY
    - 2. Unit cost
    - 3. Mark up
    - 4. Material total
  - vi. Identified labor:
    - 1. QTY
    - 2. Unit cost
    - 3. Composite labor rate
    - 4. Labor total

1.11 RECORD DRAWINGS:

- A. Maintain, on a daily basis, a complete set of "Record Drawings", reflecting an accurate record of work in accordance with the following:
  - 1. Show the complete routing and location of all feeders rated 100 amps and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.)
  - 2. Show the complete routing and location of all telecommunications conduits, systems raceways, and empty raceways, 1-1/4" and larger. Locate work buried below grade or under slab, work concealed above ceilings, and work in concealed spaces, dimensionally from fixed structural elements (not partition walls, etc.).
  - 3. Show all changes, deviations, addendum items, change orders, job instructions, etc., that change the work from that shown on the contract documents, including wall relocations, fixtures and device changes, branch circuiting changes, etc. Where locations of boxes, raceways, equipment, etc. are adjusted in the field to fit conditions, but such new locations may not be obvious by referring to the contract document, show new locations on the record drawings.
- B. At the discretion of the Architect/Engineer, the drawings will be reviewed on a periodic basis and used as a pre-requisite for progress payments. This requirement shall not be construed as authorization for the Contractor to make changes in the layout, or work without written authorization for such changes. The "Record Drawings" for daily recording shall consist of a set of blue line prints of the Contract Drawings.
- C. Upon completion of the work, purchase a complete set of electronic drawings. Transfer all "Record" information from the blue line prints to the drawings via the current CAD program that it was written. The Architect/Engineer shall review the drawings and the Contractor shall incorporate the resulting comments into the final record drawings. The



Contractor shall make two complete copies of the drawings electronically and forward this to the Engineer.

- D. Certify the "Record Drawings" for correctness by placing and signing the following certifications of the first sheet of the drawings:

"CERTIFIED CORRECT (3/8" high letters)

(Name of General Contractor)

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

(Name of Electrical Contractor)

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

1.12 GUARANTEE:

- A. Ensure that electrical system installed under this contract is in proper working order and in compliance with drawings, specifications, and/or authorized changes. Without additional charge, replace any work or materials that develop defect, except from ordinary wear and tear, within one year from the date of substantial completion. Exception: Incandescent and fluorescent lamps shall be guaranteed for a period of two months from the date of substantial completion.

1.13 OTHER:

- A. Right to Hire. "Client" agrees that during the project and for a period of twenty four (24) months following substantial completion that it will not, directly or indirectly, employ or solicit to employ BNA Personnel.

PART 2 – PRODUCTS

2.1 GENERAL:

- A. Products are specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

2.2 MANUFACTURERS:

- A. Provide products of manufacturers specified. Manufacturers catalog numbers and descriptions establish the quality of product required. Substitutions will be considered if a duplicate written application (2-copies) is at the office of the Architect/Engineer eight (8) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible

dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.

- B. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.
- C. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.
- D. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.
- E. Provide only equipment specified in the Contract Documents or approved by addendum.

## 2.3 SPARE PARTS:

- A. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

## PART 3 – EXECUTION

### 3.1 INSTALLATION:

- A. Layout electrical work in advance of construction to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary for proper installation; perform with care. Use skilled mechanics of the trades involved. Repair damage to building and equipment at no additional cost to the contract. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting structural members shall not be permitted.
- B. Since the drawings of floor, wall, and ceiling installation are made at small scale; outlets, devices, equipment, etc., are indicated only in their approximate location unless dimensioned. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned, and coordinate such locations with work of other trades to prevent interferences. Verify all dimensions on the job. Do not scale the electrical drawings, but refer to the architectural and mechanical shop drawings and project drawings for dimensions as applicable.
- C. Perform for other trades, the electrical wiring and connection for all devices, equipment or apparatus. Consult Architectural, Mechanical, and other applicable drawings, and all applicable shop drawings to avoid switches, outlets, and other equipment from being hidden behind doors, cabinets, counters, heating equipment, etc., or from being located in chalkboards, tackboards, glass panels, etc. Relocate buried electrical devices and/or connections as directed at no additional cost.
- D. Coordinate the location of outlets, devices, connections, and equipment with the supplier of the systems furniture prior to rough-in.
- E. Where conduit, outlets or apparatus are to be encased in concrete, it must be located and secured by a journeyman or foreman present at the point of installation. Check locations of the electrical items before and after concrete and/or masonry installation and relocate displaced items.

- F. Provide block-outs, sleeves, demolition work, etc., required for installation of work specified in this division.

3.2 CLEAN:

- A. Clean up all equipment, conduit, fittings, packing cartons and other debris that is a direct result of the installation of the work of this Division.
- B. Clean fixtures, interiors and exteriors of all equipment, and raceways. Replace all filters in electrical equipment upon request for Substantial Completion.

3.3 POWER OUTAGES:

- A. All power outages required for execution of this work shall occur during non-standard working hours and at the convenience of the Owner. Include all costs for overtime work in bid.
- B. Submit written request at least 7 days in advance of scheduled outage and proceed with outage only after receiving authorization from the Owner's Representative.
- C. Keep all outages to an absolute minimum.

3.4 STORAGE AND PROTECTION OF MATERIALS:

- A. Provide storage space for storage of materials and apparatus and assume complete responsibility for all losses due to any cause whatsoever. In no case shall storage interfere with traffic conditions in any public thoroughfare or constitute a hazard to persons in the vicinity. Protect completed work, work underway, and apparatus against loss or damage.

3.5 EXCAVATING FOR ELECTRICAL WORK:

- A. General: Locate and protect existing utilities and other underground work in manner that will ensure that no damage or service interruption will result from excavating and backfilling. Perform excavation in a manner that protects walls, footings, and other structural members from being disturbed or damaged in any way. Burial depths must comply with NEC Section 300-5 (or State of Utah requirement, whichever is more stringent), unless noted otherwise on drawings.
- B. Protect persons from injury at excavations, by barricades, warnings and illumination.
- C. Coordinate excavations with weather conditions, to minimize possibility of washouts, settlements and other damages and hazards.
- D. Provide temporary covering or enclosure and temporary heat as necessary to protect bottoms of excavations from freezing and frost action. Do not install electrical work on frozen excavation bases or sub-bases.
- E. Do not excavate for electrical work until the work is ready to proceed without delay, so that total time lapse from excavation to completion of backfilling will be minimum. See other sections of specification for additional requirements for excavating.
- F. Store excavated material (temporarily) near excavation, in a manner that will not interfere with or damage excavation or other work. Do not store under trees (within drip line).

- G. Retain excavated material that

### 3.6 BACKFILL MATERIALS:

- A. For buried conduit or cable (other than below slab-on-grade, or concrete encased) - 2" thickness of well graded sand on all side of conduit or cable.
- B. For trench backfill to within 6" of final grade - soil material suitable for compacting to required densities.
- C. For top 6" of excavation - Top soil.
- D. Backfill excavations in 8" high courses of backfill material, uniformly compacted to the following densities (percent of maximum density, ASTM D 1557), using power-driven hand-operated compaction equipment.
  - 1. Lawn/Landscaped Areas: 85 percent for cohesive soils, 95 percent for cohesionless soils.
  - 2. Paved Areas, Other than Roadways (90 percent for cohesive soils, 95 percent for cohesionless soils).
- E. Subsidence: Where subsidence is measurable or observable at electrical work excavations during general project warranty period, remove surface (pavement, lawn or other finish), add backfill material, compact, and replace surface treatment. Restore appearance, quality and condition of the surface or finish to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

### 3.7 ROOF PENETRATIONS:

- A. Where raceways penetrate roofing or similar structural area, provide appropriate roof jack coordinate with the roofing contractor and the Architect in order to match the vent with the roof construction. The jack shall be sized to fit tightly to raceway for weather-tight seal, and with flange extending a minimum of 9" under roofing in all sides or as required by the roof type of construction. Completely seal opening between inside diameter of roof flashing and outside diameter of penetrating raceways. Coordinate all work with work required under roofing section of specifications.

### 3.8 FIRE PENETRATION SEALS:

- A. Seal all penetrations for work of this section through fire rated floors, walls and ceilings to prevent the spread of smoke, fire, toxic gas or water through the penetration either before, during or after fire. The fire rating of the penetration seal shall be at least that of the floor, wall or ceiling that it is installed, so that the original fire rating of the floor or wall is maintained as required by Article 300-21 of the National Electrical Code. Where applicable, provide OZ Type CFSF/I and CAFSF/I fire seal fittings for conduit and cable penetrations through concrete and masonry walls, floors, slabs, and similar structures. Where applicable, provide [3M](#) CID cast-in device for floor slabs. Where applicable, provide [3M](#) fire barrier sealing penetration system, and/or IPC Flame Safe Fire Stop System, and/or Chase Foam fire stop system, including wall wrap, partitions, caps, and other accessories as required. All materials to comply with UL 1479 (ASTM E-814). Comply with manufacturer's instructions and recommendations for installation of sealing fittings and barrier sealing systems.

3.9 PROJECT FINALIZATION AND START-UP:

- A. Upon completion of equipment and system installation, assemble all equipment Factory Representatives and Subcontractors for system start-up.
- B. Each Representative and Subcontractor shall assist in start-up and check out their respective system and remain at the site until the total system operation is accepted by the Owner's representative.
- C. The Factory Representative and/or System Subcontractor shall give personal instruction on operating and maintenance of their equipment to the Owner's maintenance and/or operation personnel. To certify acceptance of operation and instruction by the Owner's Representative, the contractor shall prepare a written statement as follows:
  - 1. This is to certify that the Factory Representative and System Subcontractor for each of the systems listed below have performed start-up and final check out of their respective systems.
  - 2. The Owner's Representative has received complete and thorough instruction in the operation and maintenance of each system.

SYSTEM	FACTORY REPRESENTATIVE
(List systems included)	(List name and address of Factory Representative)

_____ Owner's Representative	_____ Contractor
---------------------------------	---------------------

- D. Send copy of acceptance to Architect/Engineer.

3.10 FINAL REVIEW:

- A. At the time of final review, the project foreman shall accompany the reviewing party, and remove coverplates, panel covers and other access panels as requested, to allow review of the entire electrical system.

END OF SECTION 26 0500

BLANK PAGE

## SECTION 26 0502 - ELECTRICAL SUBMITTALS AND O & M MANUALS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to all Division 26, 27 and 28 sections.
- B. Architectural, Structural, Mechanical and other applicable documents are considered a part of the electrical documents insofar as they apply as if referred to in full. Contractor must review the entire set of plans and specifications. Reviewing only the electrical set is not acceptable.
- C. Consult all other sections, determine the extent and character of related work and properly coordinate work specified herein with that specified elsewhere to produce a complete installation.

#### 1.2 SUBMITTAL REQUIREMENTS:

##### A. GENERAL:

- 1. After the Contract is awarded but prior to ordering, manufacture, or installation of any equipment, prepare complete Submittals including shop drawings, product data, brochures, etc. for materials and equipment as required by each section of the specification.
- 2. Review of Submittals shall not relieve the Contractor of responsibility for dimensions and/or errors that may be contained therein, or deviations from the Contract Document's requirements. It shall be clearly understood that the noting of some errors but overlooking others does not grant the Contractor permission to proceed in error. Regardless of any information contained in the Shop Drawings and Brochures, the requirements of the Contract Document's shall govern and are not waived, or superseded in any way by the review of the Shop Drawings and Brochures.
- 3. Submittals are reviewed, not approved. Comments made within submittals do not alter the contract documents in any way. The contractor is still responsible, regardless of comments (if any) made within submittals, for complying with drawings and specifications.
- 4. Notify engineer in writing if any of the comments noted in the submittals alter the contract cost. A comment within the submittal process which increases/decreases cost of product is not an authorization to the contractor under any circumstances to proceed.
- 5. Notify engineer of any modifications between contract documents and submittals. It is the responsibility of the contractor to ensure compliance.
- 6. ELECTRONIC SUBMITTAL REQUIREMENTS:
  - a. Provide submittals in Portable Document Format (PDF).

- b. Documents must be electronically bookmarked and keyword searchable using Adobe Acrobat (<http://www.adobe.com/acrobat>) or Bluebeam Revu (<http://www.bluebeam.com>) for each relevant section. For example, include electronic bookmarks separating “Light Fixtures” from “Panelboards”.
- c. Electronically highlight all options for light fixtures, electrical equipment, etc. Manual highlighting and scanning of the documents is NOT acceptable and will NOT be reviewed.
- d. Provide only completed cutsheets for all fixture and equipment types. Blank cutsheets submitted with a schedule are NOT acceptable and will NOT be reviewed.
- e. At the time of submission, the electrical contractor shall provide a complete and comprehensive submission of all required specification sections/shop drawings at the same time. Exceptions may be given, with prior approval, for time-sensitive equipment.
- f. A maximum of one submittal per specification section is allowed. It is NOT acceptable to provide a product by product submittal. Single product by product submittals will NOT be reviewed.

B. SCHEDULING

1. GENERAL

- a. A minimum period of two weeks, exclusive of transmittal time, will be required each time Submittals are submitted or resubmitted for review. This time period shall be considered by the Contractor when scheduling submittal data.
- b. If the shop drawings are rejected twice, the contractor shall reimburse the engineer the sum of \$1,200.00 for the third review and any additional reviews required prior to commencement of the third review.

C. QUALITY ASSURANCE

1. PRE-SUBMITTAL PREPARATION

- a. Prior to submission of the Shop Drawings and Project Data, review and certify that they are in compliance with the Contract Documents. Verify all dimensional information to ensure proper clearance for installation of equipment.
- b. Shop drawings requiring the use of electronic documents (floor plans, Lighting plans, fire alarm plans, etc.) shall be requested via a request for information (RFI) through the general contractor. Electronic documents will be provided to the Architect for distribution. No direct vendor requests will be accepted.
- c. Contractor is completely responsible for the content of the submittal

2. SUBMITTAL REQUIREMENTS

- a. Certifications shall be written or in the form of rubber stamp impressions as follows:
  - i. I hereby certify that this Shop Drawing and/or Brochure has been checked prior to submittal and that it complies



in all respects with the requirements of the Contract Drawings and Specifications for this Project.

(Name of Electrical Subcontractor)

Name\_\_\_\_\_.

Position\_\_\_\_\_Date\_\_\_\_\_.

- b. Brochures to be submitted shall be published by the Manufacturers and shall contain complete and detailed engineering and dimensional information. Brochures submitted shall contain only information relevant to the particular equipment or materials to be furnished. The Contractor shall not submit catalogs that describe several different items in addition to those items to be used, unless all irrelevant information is marked out, or unless relevant information is clearly marked. Brochures from each manufacturer shall be identified and submitted separately.
- c. Shop Drawings shall be done in an easily legible scale and shall contain sufficient plans, elevations, sections, and isometrics to clearly describe the equipment or apparatus, and its location. Drawings shall be prepared by an Engineer/Draftsman skilled in this type of work. Shop Drawings shall be drawn to at least 1/4" = 1'0" scale.
- d. Observe the following rules when submitting the Shop Drawings and Brochures.
  - i. Each Shop Drawing shall indicate in the lower right hand corner, and each Brochure shall indicate on the front cover the following: Title of the sheet or brochure, name and location of the building; names of the Architect and Electrical Engineer, Contractor, Subcontractors, Manufacturer, Supplier/Vendor, etc., date of submittal, and the date of correction and revision. Unless the above information is included the submittal will be returned for resubmittal.
    - 1. Submittal Identification shall include the following:
      - a. A unique number, sequentially assigned, shall be noted on the transmittal form accompanying each item submitted.
      - b. Original submittal numbers shall have the following format: "XXX-Y;" where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals (for example, A, B, or C being the first, second, and third resubmittals, respectively). Submittal 25B, for example, is the second resubmittal of

Submittal 25.

e. SPECIFICATION section and paragraph to which submittal applies.

D. POST-SUBMITTAL

1. Check all materials and equipment after arrival on the job site and verify compliance with the Contract Documents.

1.3 PROVIDE SUBMITTALS AS REQUESTED FOR EACH OF THE SECTIONS LISTED BELOW:

A. 26 0533 Electrical Boxes and Fittings

1. Submit manufacturer's data including specifications, installation instruction and general recommendations for each type of floor box used on project.

B. 26 0553 Electrical Identification

1. Submit manufacturer's data on each type of electrical identification products
  - a. Submit one sample of each component of the electrical identification system as follows: Wire/cable tape marker, Tags, Engraved, plastic laminate labels, Arc-flash hazard labels

C. 26 0943 Lighting Control Equipment

1. Submit manufacturer's data on lighting control equipment including, but not limited to published catalog data sheets, rough-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
2. Meet with the electrical engineer at their office prior to preparation of shop drawings to discuss and verify specific programming and zoning requirements of system(s).
3. Meet with the lighting representative/manufacturer of the approved and accepted lighting control equipment to verify and understand specific installation requirements associated with that system.
4. Submit detailed drawings and documentation of lighting control components and interconnection including, but not necessarily limited to:
  - a. Electronic controllers
  - b. Control stations
  - c. Photo sensors
  - d. Occupancy sensors
  - e. Network wiring details
  - f. Input and output wiring details
  - g. Lighting control panel load schedules
  - h. Provide a complete sequencing and programming schedules for all devices, zones and scenes.

- i. Wallstations layouts
  - j. Accurately scaled equipment layouts, wire/cable routing and connections to control wiring and electrical power feeders.
- D. 26 2726 Wiring Devices
  - 1. Submit manufacturer's data on electrical wiring devices.
- E. 26 5100 Interior and Exterior Building Lighting
  - 1. Submit manufacturer's data on interior and exterior building lighting fixtures.
  - 2. Submit dimensioned drawings of lighting fixtures. Submit fixture shop drawings in PDF format with separate sheet for each fixture, assembled in luminaire "type" alphabetical order, with proposed fixture catalog number and accessories clearly indicated on each sheet.
  - 3. When applicable submit standard color samples with the shop drawings. If standard colors are not acceptable, a color sample will be provided to the fixture manufacturer. Return of the shop drawings will be delayed until color samples are provided.
  - 4. Submit ballast and driver manufacturer cut sheets.
- F. 27 1500 Canyons School District – Network Cabling Global Specification
  - 1. See district specifications for exact submittal requirements.
  - 2. Provide proof of RCDD certification and connectivity manufacturer certification.
  - 3. Provide submittals for all racks/cabinets; patch panels, devices, cabling, firestopping solutions, tray, non-continuous cable support devices, grounding equipment, and miscellaneous equipment to be used on project. Where multiple part numbers are listed on a datasheet/cutsheet, highlight or circle applicable part.
  - 4. Provide color samples of all available standard color faceplates to architect.
  - 5. Provide proposed labeling scheme for approval by owner/engineer.
  - 6. Provide catalog cutsheets of all test equipment that will be used.
- G. 27 5123 - Intercommunication Systems– Update System and Programming as required
  - 1. Submit manufacturer's data on intercom system devcies including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
  - 2. Provide shop drop drawings updating existing system.
- H. 28 3111 Fire Alarm and Detection System – Update System and Programming as required:
  - 1. Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.

2. Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic. Shop drawings shall be prepared by an individual with a minimum NICET Level IV (Fire Protection Engineering/Fire Alarm Systems) certification. The individual's name and certification number shall be indicated on submittal design drawings.
3. Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.
4. Submit a complete set of documents to the Office of the State Fire Marshal containing the following information:
  - a. A complete set of shop drawings indicating:
    - i. Location of all alarm-initiating and alarm-signaling devices.
    - ii. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.
  - b. Wiring diagrams for:
    - i. Alarm control panels.
    - ii. Auxiliary function relays and solenoids.
    - iii. Remote signaling equipment.
    - iv. Standby battery calculations, including voltage drop calculation.
  - c. A complete equipment list identifying:
    - i. Type
    - ii. Model
    - iii. Manufacturer
    - iv. Manufacturer catalog data sheets
    - v. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)
  - d. A complete zone list identifying all:
    - i. Alarm-initiating and alarm-signaling devices.
    - ii. Remote signaling and auxiliary function zones.
    - iii. Specific devices associated with each zone.
  - e. Sample "System Record Document".
  - f. Fire Alarm Key Plan Drawing showing the location of all device addresses and/or zones.

#### 1.4 OPERATION & MAINTENANCE MANUALS

- A. Provide operating instruction and maintenance data books for all equipment and materials furnished under this Division.
- B. Submit four copies of operating and maintenance data books for review at least four weeks before final review of the project. Assemble all data in a completely indexed volume or volumes and identify the size, model, and features indicated for each item. The binder (sized to the material) shall be a 2" slide lock unit (Wilson-Jones WLJ36544B). The cover shall be engraved with the job title in 1/2" high letters and the name and address of the Contractor in 1/4" high letters. Provide the same information in 1/8" letters on the spine.
- C. Include complete cleaning and servicing data compiled in clearly and easily understandable form. Show serial numbers of each piece of equipment, complete lists of replacement parts, motor ratings, etc. Each unit shall have its own individual sheet. (Example: If two items of equipment A and D appear on the same sheet, an individual sheet shall be provided for each unit specified).
- D. Include the following information where applicable.
  - 1. Identifying name and mark number.
  - 2. Certified outline Drawings and Shop Drawings.
  - 3. Parts lists.
  - 4. Performance curves and data.
  - 5. Wiring diagrams.
  - 6. Light fixture schedule with the lamps and ballast data used on the project for all fixtures
  - 7. Manufacturer's recommended operating and maintenance instructions.
  - 8. Vendor's name and address for each item.
- E. The engineer will review the manuals and when approved, will forward the manuals on to the architect. If the manuals are rejected twice, the contractor shall reimburse the engineer the sum of \$1,200.00 for each review afterwards.
- F. Provide high quality video and audio recording for all training sessions. All trainings shall be recorded by utilizing a pro-grade digital camera system. Utilize camera tripod and record audio directly at the presenter. Smartphone recordings are not allowed.
- G. Provide Operation and Maintenance Manual information for each section listed below in addition to the general requirements listed above.
  - 1. 26 0943 Lighting Control Equipment
    - a. Record Drawings
      - i. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
      - ii. Provide a DIGITAL COPY to the owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to

change the schedules themselves. The DIGITAL COPY shall contain a minimum of following:

1. CAD drawing files of 'as-built' lighting control components and point to point connections.
  2. General configuration programming.
  3. Job specific configuration programming to include schedule.
  4. Tutorial file on complete programming of lighting control system.
2. 26 5100 Interior and Exterior Building Lighting
  - a. The supply two complete manuals consisting of, as a minimum, general system arrangement, lighting cutsheets, schematic of System components and options, factory test reports, trouble-shooting data, parts lists, preventative maintenance information, and warranty contact information.
3. 27 1500 Canyons School District – Network Cabling Global Specification
  - a. Adhere to district specific requirements outlines within specifications.
  - b. Test Results as outlined in Section 27 1500
  - c. Manual shall include all service, installation, programming and warranty, including test results for each cable.
  - d. Provide laminated plans (minimum size 11 x 17) of all telecommunications record drawings (including riser diagrams) in each and every EF, ER and TR.
  - e. Record Drawings
    - i. The Owner shall provide electronic (DWG) format of telephone/data system drawings that as-built construction information can be added. These documents will be modified accordingly by the telecommunications contractor to denote as-built information as defined above and returned to the Owner.
    - ii. Provide a complete set of "as built" drawings in paper and electronic (DWG and PDF) formats showing cabinets, racks, patch panels, wiring, specific interconnections between all equipment and internal wiring of equipment within 30 working days of completion. Drawings are to include all labeling information used in denoting equipment used in the installation. Labeling, icons, and drawing conventions used shall be consistent throughout all documentation provided.
4. 27 4100 Audiovisual Systems
  - a. Provide a list of finish options for selection. Do not order any equipment if finishes have not been selected on the shop drawings.

- b. Provide shop drawings for 27 4100 at the time of original shop drawing submission. Do not order AV equipment from the first submission. One hundred and twenty (120) days prior to the time of AV equipment installation, provide a second submission of AV equipment only. Provide current equivalent if specified model has been discontinued.
- c. The following items shall be included in the shop drawings submittal:
  - i. Project manager's written proof, with signature and date, that shop drawings and/or brochure has been checked for accuracy prior to submittal. Shop drawings to comply in all respects with the requirements of the contract drawings and specifications for this project.
  - ii. A complete bill of materials, broken out per system type, for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.
    - 1. The bill of material is intended to be used to verify equipment within each system. Only one cut sheet per unique product type is required.
    - 2. Example several systems may require the same flat panel display mount, that mount should be listed in each system type with only one (1) cut sheet provided for that product.
  - iii. Manufacturer's data sheets and installation details for all devices, plates, cables and similar equipment. Product data showing multiple options, products and/or models shall be clearly marked identifying the specific options, products and/or models being provided.
  - iv. Signal flow drawings showing all audio, video, control, network and power connections required between all pieces of equipment within each system.
    - 1. Unique cable/wire identifier for each connection that correspond to field cabling labelling scheme.
    - 2. All connections require connector type and male/female termination to be identified. Type shall correspond to a connector legend or shall be clearly identified per instance.
    - 3. Wiring pinouts for all multipin connectors used
    - 4. Detailed panel drawings showing wall, floor, rack, etc. input/output panel dimensions, connector types and text labeling for each connection shown
    - 5. Physical location information for each device.
    - 6. Upon request AV Consult's signal flow drawings

may be utilized for signal flow documentation within the shop drawings, provided, the items above are included. Contractor shall make request for electronic files as indicated in section 1.2.C.

- v. Equipment rack elevations.
  - vi. Matrix routing and preset configuration tables, and digital signal processing configuration details.
  - vii. Wireless microphone transmission frequencies.
  - viii. Submit all manufacturer training, 3rd party and/or organization certificates for each equipment and/or systems required for the implementation of this specification.
- d. All touch panel layouts, page logic functions and control system functionality, shall be submitted and approved by the Owner and AV Consultant prior to installation and programming of the control systems. Contractor shall submit the following information at the following stages during the construction of the GUI.
- i. Draft Stage: Draft drawings and/or sketches of; basic layouts, button details, text details and page flip progression. Include control schemes for all applicable devices in system.
  - ii. Intermediate Stage: Intermediate Touch Panel Menus designed with manufacturer's software. Submit printouts and/or software files for review. Include detailed layouts, extensive control schemes for all controlled components, comprehensive button and text configurations, page flips and pop-up progression. Incorporate any changes or comments from previous stage mentioned above.
  - iii. Demo Stage: Provide an active Touch Panel and controller to extensively demonstrate the operation of the control system. Demo of system shall be subject for review and considered as a deliverable. Include all revised detailed layouts, extensive control schemes for all controlled components, comprehensive button and text configurations, page flips and pop-up progression. Incorporate any changes or comments from the previous stage mentioned above.
  - iv. Final Stage: Submit Final Touch Panel Menus designed with manufacturer's software. Submit printouts and software files for review. Include all detailed layouts, all revised control schemes for all controlled components, revised button and text configurations, page flips and pop-up progression. Include final page configurations for control of system from the touch panel. Incorporate any



and all changes or comments from the previous stage mentioned above.

5. 27 5123 Intercommunications System
  - a. Provide updated programming and as-built drawings.
6. 28 1600 Security Systems
  - a. Provide updated programming and as-built drawings.
7. 28 3111 Fire Alarm and Detection System
  - a. Manual Requirements
    - i. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.
  - b. Record Drawings
    - i. A complete updated set of CAD "as-built" drawings showing installed wiring, color coding, specific interconnections between all equipment, and internal wiring of the equipment shall be delivered to the owner upon completion of the system. Vendor shall not request drawings from the Engineer. Vendor shall request current architectural drawings from the Architect and include all cost with bid.
    - ii. A building map shall be supplied to the owner indicating the exact location of all devices along with the addresses of the individual devices. Install building fire alarm map adjacent to the fire alarm panel and all remote operating panels. Provide high quality plastic sign (map holder) with two layers. The back layer shall be painted black. The front layer shall be a clear center for viewing the CAD fire alarm drawing. Edges of the sign shall be colored to match the building interior. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).
    - iii. Provide a DIGITAL COPY to the Owner containing the information specified below. The DIGITAL COPY shall include all information required to allow the Owner to change the fire alarm program themselves. The DIGITAL COPY shall contain a minimum of the following:
      1. CAD drawing files of building fire alarm map.
      2. CAD drawing files of as-built fire alarm components and point to point connections.
      3. General configuration programming.
      4. Job specific configuration programming.

- c. Final Submittal to the Office of the Fire Marshal
  - i. Record of Completion: Provide a completed System Record of Completion (NFPA 72-Figure 4.5.2.1) in accordance with Section 4.5.3.
  - ii. Operation Instructions and A-Built Drawings: Provide one set of instructions on operation of the Fire Alarm System and one set of As-Built drawings. Demonstrate compliance of installation of the System Record Documents at or near the fire alarm control unit.
  - iii. Fire Alarm Key Plan Drawing: Demonstrate compliance of installation of the fire alarm key plan drawing at the FACP.
  - iv. TUTORIAL FILE ON COMPLETE PROGRAMMING OF FIRE ALARM SYSTEM

END OF SECTION 26 0502

## SECTION 26 0507 - ELECTRICAL CONNECTIONS FOR EQUIPMENT

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-23 section making reference to electrical connections.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of electrical connection for equipment includes final electrical connection of all equipment having electrical requirements. Make final connections for all owner furnished equipment. See other applicable portions of specification for building temperature control wiring requirements.
- B. Refer to Division-23 sections for motor starters and controls furnished integrally with equipment; not work of this section.
- C. Refer to Division-23 section for control system wiring; not work of this section.
- D. Refer to sections of other Divisions for specific individual equipment power requirements.

#### 1.3 QUALITY ASSURANCE:

- A. NEC COMPLIANCE: Comply with applicable portions of NEC as to type products used and installation of electrical power connections.
- B. UL LABELS: Provide electrical connection products and materials that have been UL-listed and labeled.

### PART 2 - PRODUCTS

#### 2.1 GENERAL:

- A. For each electrical connection indicated, provide complete assembly of materials, including but not necessarily limited to, raceways, conductors, cords, cord caps, wiring devices, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire nuts, and other items and accessories as needed to complete splices, terminations, and connections as required. Crimp on or slip-on type splicing materials (insulation displacement type) designed to be used without wire stripping are not acceptable. See Section 26 0532, Conduit Raceways; Section 26 2726 Wiring Devices; and Section 26 0519 Conductors and Cables for additional requirements. Provide final connections for equipment consistent with the following:
  - 1. Permanently installed fixed equipment - flexible seal-tite conduit from branch circuit terminal equipment, or raceway; to equipment, control cabinet, terminal junction box or wiring terminals. Totally enclose all wiring in raceway.

2. Movable and/or portable equipment - wiring device, cord cap, and multi-conductor cord suitable for the equipment and in accordance with NEC requirements (Article 400).
3. Other methods as required by the National Electrical Code and/or as required by special equipment or field conditions.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF ELECTRICAL CONNECTIONS:

- A. Make electrical connections in accordance with connector manufacturer's written instructions and with recognized industry practices, and complying with requirements of NEC and NECA's "Standard of Installation" to ensure that products fulfill requirements.
- B. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams.
- C. Coordinate installation of electrical connections for equipment with equipment installation work.
- D. Verify all electrical loads (voltage, phase, horse power, full load amperes, number and point of connections, minimum circuit ampacity, etc.) for equipment furnished under other Divisions of this specification, by reviewing respective shop drawings furnished under each division. Meet with each subcontractor furnishing equipment requiring electrical service and review equipment electrical characteristics. Report any variances from electrical characteristics noted on the electrical drawings to Architect before proceeding with rough-work. In summary, it is not in the Electrical Engineers scope to review the shop drawings from other trades/divisions.
- E. Obtain and review the equipment shop drawings to determine particular final connection requirements before rough-in begins for each equipment item.
- F. Refer to basic materials and methods Section 26 0553 Electrical Identification, Conductors, for identification of electrical power supply conductor terminations.

END OF SECTION 26 0507

SECTION 26 0519 - CONDUCTORS AND CABLES (600V AND BELOW)

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to conductors and cables specified herein.

1.2 DESCRIPTION OF WORK:

- A. Extent of electrical conductor and electrical cable work is indicated by drawings and schedules.
- B. Types of conductors and cables in this section include the following:
  - 1. Copper Conductors (600V)
  - 2. Aluminum Conductor (600V)
  - 3. 0-10V Class 1 Circuits
- C. Applications for conductors and cables required for project include:
  - 1. Power Distribution
  - 2. Feeders
  - 3. Branch Circuits
  - 4. 0-10V Class 1 Circuits

1.3 RECORDS SUBMITTAL:

- A. Submit record in triplicate of megohmmeter readings to Architect/Engineer. Please see paragraphs 3.2A AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW for testing requirements.

1.4 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to construction and installation of electrical conductors and cable. Comply with UL standards and provide electrical conductors and cables that have been UL-listed and labeled.
- B. Comply with applicable portions of NEMA/Insulated Cable Engineers Association standards pertaining to materials, construction and testing of conductors and cable.
- C. Comply with applicable portions of ANSI/ASTM and IEEE standards pertaining to construction of conductors and cable.

1.5 SUBMITTALS:

- A. Refer to Section 26 0502 for electrical submittal requirements.

## PART 2 - PRODUCTS

### 2.1 COPPER AND ALUMINUM CONDUCTORS (600V):

- A. Provide factory-fabricated conductors of sizes, ratings, materials, and types indicated for each service. Where not indicated provide proper selection to comply with project's installation requirements and NEC standards. Provide conductors in accordance with the following:
  - 1. Service Entrance Conductors – Copper/Aluminum conductor; see drawings for insulation type.
  - 2. Distribution and Panelboard Feeders; and Other Conductors, #2 AWG and Larger – Copper/Aluminum conductor; see drawings for insulation type.
  - 3. Branch Circuit Conductors and All Conductors #3 AWG and Smaller - Copper conductor, with THHN/THWN insulation. Size all conductors in accordance with NEC; minimum size to be #12 AWG.
  - 4. Aluminum Conductors. Where aluminum conductors are specified for use, provide compact stranded Aluminum Association 8000- series alloy conductor material.
    - a. [Stabiloy - Alcan Cable](#)
    - b. [Triple E - Southwire](#)
- B. Provide connectors and terminations for aluminum-alloy conductors of hydraulic compression type only, listed under UL 486-B, and marked "AL 7CU" for 75o rated circuits, and "AL9CU" for 90o rated circuits.
- C. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
- D. Provide neutral and ground wire as specified elsewhere in documents.
- E. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.

### 2.2 FIRE-RESISTIVE CABLE:

- A. Mineral Insulated Copper (MI) Copper Sheathed Cable:
  - 1. General:
    - a. Provide 1/c type system 1850 sheathed power cable, conforming to current standards of UL system No. 1850.
    - b. Cable shall be classified as 2-hour fire resisting cable and shall comply with NEC articles 695 and 700 as an "Electrical Circuit Protective System" with a minimum 2-hour fire rating.
    - c. Construct cable with copper conductor with highly compressed

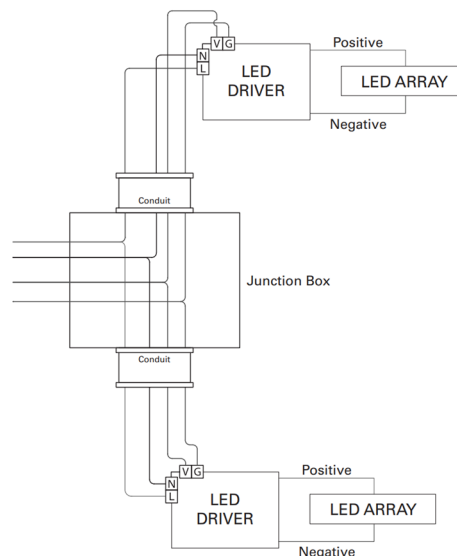
- magnesium oxide insulation and seamless soft-drawn copper sheath.
      - d. Provide termination kits as recommended by cable manufacturer.
  - 2. Manufacturer:
    - a. Subject to compliance with requirements, provide products of one of the following:
      - i. Pentair – Pyrotex System 1850

## 2.3 COPPER LOW VOLTAGE CONDUCTORS (0-10V CIRCUITS):

### A. 0-10V Class 1 Circuits:

#### 1. General:

- a. Provide Class 1 circuits for all 0-10V dimming installations. Class 1 circuits shall be permitted to be installed with other circuits as specified in NEC 725.48 (A) and (B):
  - i. Class 1 circuits shall be permitted to occupy the same cable, cable tray, enclosure, or raceway without regard to whether the individual circuits are alternating or direct current, provided all conductors are insulated for the maximum voltage of any conductors in the cable, cable tray, enclosure or raceway.
  - ii. Class 1 circuits shall be permitted to be installed with power supply conductors as specified:
    - 1. Class 1 and power supply circuits shall be permitted to occupy the same cable, enclosure, or raceway only when functionally associated.
  - iii. Utilize purple and grey copper conductors, with THHN/THWN insulation.



### PART 3 - EXECUTION

#### 3.1 INSTALLATION:

- A. General: Install electric conductors and cables as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standards of Installation", and in accordance with recognized industry practices.
- B. Coordinate installation work with electrical raceway and equipment installation work, as necessary for proper interface.
- C. Cables may be pulled by direct attachment to conductors or by use of basket weave pulling grip applied over cables. Attachment to pulling device shall be made through approved swivel connection. Nonmetallic jacketed cables of small size may be pulled directly by conductors by forming them into a loop that pull wires can be attached; remove insulation from conductors before forming the loop. Larger sizes of cable may be pulled by using basket weave pulling grip, provided the pulling force does not exceed limits recommended by manufacturer; if pulling more than one cable, bind them together with friction tape before applying the grip. For long pulls requiring heavy pulling force, use pulling eyes attached to conductors.
- D. Do not exceed manufacturer's recommendations for maximum allowable pulling tension, side wall pressure, and minimum allowable bending radius. In all cases, pulling tension applied to the conductors shall be limited to 0.008 lbs. per circular mil of conductor cross-section area.
- E. Pull in cable from the end having the sharpest bend; i.e. bend shall be closest to reel. Keep pulling tension to minimum by liberal use of lubricant, and turning of reel, and slack feeding of cable into duct entrance. Employ not less than one man at reel and one in pullhole during this operation.
- F. For training of cables, minimum bend radius to inner surface of cable shall be 12 times cable diameter.
- G. Where cable is pulled under tension over sheaves, conduit bends, or other curved surfaces, make minimum bend radius 50% greater than specified above for training.
- H. Use only wire and cable pulling compound recommended by the specific cable manufacturer, and that is listed by UL.
- I. Seal all cable ends unless splicing is to be done immediately. Conduit bodies shall not contain splices.
- J. Support all cables in pullholes, concrete trenches, and similar locations by cable racks and secure to rack insulators with nylon cord or self-locking nylon cable ties. Place each cable on separate insulator. In manholes, pullholes, concrete trenches, and similar locations, wrap strips of fire-proofing tape (approx. 1/16 inch thick by 3 inches wide) tightly around each cable spirally in half-lapped wrapping or in two butt-joined wrappings with the second wrapping covering the joints in the first. Apply tape with the coated side toward the cable, and extend tape one inch into the ducts. To prevent unraveling, random wrap the fireproofing tape the entire length of the fireproofing with pressure sensitive glass cloth tape. Provide fireproofing tape of a flexible, conformable fabric having one side coated with flame retardant, flexible, polymeric coating and/or a chlorinated elastomer not less than 0.050 inch thick weighing not less than 2.5 pounds per



square yard. Provide tape that is noncorrosive to cable sheath, self-extinguishing, and that will not support combustion. Construct tape of materials that do not deteriorate when subjected to oil, water, gases, salt water, sewage and fungus.

K. Follow manufacturer's instructions for splicing and cable terminations.

3.2 AFTER INSTALLATION TEST FOR CABLE 600 VOLTS AND BELOW:

A. Prior to energization, test cable and wire for continuity of circuitry, and for short circuits, Megger all circuits of 100 amp and greater rating. Correct malfunctions. Record all test data and provide written test report.

B. Subsequent to wire and cable connections, energize circuitry and demonstrate functioning in accordance with requirements.

3.3 IDENTIFICATION OF FEEDERS: Refer to Section 26 0553 for requirements.

END OF SECTION 26 0519

BLANK PAGE

## SECTION 26 0526 - GROUNDING

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

#### 1.2 DESCRIPTION OF WORK:

- A. Provide grounding as specified herein, and as indicated on drawings.
- B. Provide grounding and bonding of all electrical and communication apparatus, machinery, appliances, building components, and items required by the NEC to provide a permanent, continuous, low impedance, grounding system.
- C. Unless otherwise indicated, ground the complete electrical installation including the system neutral, metallic conduits and raceways, boxes, fittings, devices, cabinets, and equipment in accordance with all code requirements.
- D. Ground each separately derived system, as described in NEC Section 250-30, unless otherwise indicated.
- E. Types of grounding in this section include the following:
  - 1. Enclosures
  - 2. Systems
  - 3. Equipment
  - 4. Other items indicated on drawings
- F. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

#### 1.3 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to electrical grounding and ground fault protection systems. Comply with applicable ANSI and IEEE requirements. Provide products that have been UL listed and labeled.
- B. Resistance from the service entrance ground bus, through the grounding electrode to earth, shall not exceed 5 ohms.

#### 1.4 SUBMITTALS:

- A. Not Required.

## PART 2 – PRODUCTS

### 2.1 MATERIALS AND COMPONENTS:

- A. GENERAL: Except as otherwise indicated, provide each electrical grounding system as specified herein, and as shown on drawings, including but not necessarily limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes and plate electrodes, bonding jumper braid, and other items and accessories needed for complete installation. Where materials or components are not otherwise indicated, comply with NEC, NEMA and established industry standards for applications indicated.
- B. ELECTRICAL GROUNDING CONDUCTORS: Unless otherwise indicated, provide electrical grounding conductors for grounding connections matching power supply wiring materials and sized according to NEC. Provide with green insulation.

## PART 3 - EXECUTION

### 3.1 INSTALLATION OF GROUNDING SYSTEMS:

- A. Install electrical grounding systems in accordance with manufacturer's written instructions and with recognized industry practices to ensure grounding devices comply with requirements.
- B. Install clamp-on connectors only on thoroughly cleaned and metal contact surfaces, to ensure electrical conductivity and circuit integrity.
- C. Provide grounding for the entire raceway, enclosure, equipment and device system in accordance with NEC. All non-metallic raceways shall include copper grounding conductor sized in accordance with NEC. Include copper grounding conductor in all raceway installed in suspended slabs.
- D. Provide service entrance grounding by means of ground rods (quantity of two, driven exterior to building), by means of bonding to water main, and by means of bonding to building structural steel. In addition, provide a grounding electrode for not less than 30 lineal feet in concrete footing or foundation that is in direct contact with earth. Size electrode in accordance with NEC, but in no case, smaller than No. 4 AWG bare copper. Support electrode so as to be below finished grade near the bottom of the trench, and approximately three inches from the bottom or sides of the concrete. Locate a point of connection for inspection.
- E. Provide grounding conductors for dimming systems in accordance with manufacturer's requirement.

END OF SECTION 26 0526

## SECTION 26 0529 - SUPPORTING DEVICES

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification section, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to supports, anchors, sleeves, and seals, specified herein.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of supports, anchors, and sleeves is indicated by drawings and schedules and/or specified in other Division-26 sections. See Section 260532, Raceways, for additional requirements.
- B. Work of this section includes supports, anchors, sleeves and seals required for a complete raceway support system, including but not limited to: clevis hangers, riser clamps, C-clamps, beam clamps, one and two hole conduit straps, offset conduit clamps, expansion anchors, toggle bolts, threaded rods, U-channel strut systems, threaded rods and all associated accessories.

#### 1.3 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to construction and installation of electrical supporting devices. Comply with applicable requirements of ANSI/NEMA Std. Pub No. FB 1, "Fittings and Supports for Conduit and Cable Assemblies". Provide electrical components that are UL-listed and labeled.

### PART 2 - PRODUCTS

#### 2.1 MANUFACTURED SUPPORTING DEVICES:

##### A. GENERAL:

- 1. Provide supporting devices; complying with manufacturer's standard materials, design and construction in accordance with published product information, and as required for a complete installation; and as herein specified. See drawings for additional requirements.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF SUPPORTING DEVICES:

- A. Install hangers, anchors, sleeves, and seals as required, in accordance with manufacturer's written instructions and with recognized industry practices to ensure supporting devices comply with requirements. Comply with requirements of NECA, NEC and ANSI/NEMA for installation of supporting devices.

- B. Coordinate with other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.
- C. Install hangers, supports, clamps and attachments to support piping properly from building structures. Arrange for grouping of parallel runs of horizontal conduits to be supported together on trapeze type hangers where possible. For pre-and post tensioned construction, use pre-set inserts for support of all electrical work. Do not use toggle bolts, moly bolts, wood plugs or screws in sheetrock or plaster as support for any equipment or raceway.
- D. Independent support wires are not allowed as indicated as per NEC 300.11(B).
- E. RACEWAYS:

- 1. Support raceways that are rigidly attached to structure at intervals not to exceed 8 feet on center, minimum of two straps per 10 foot length of raceway, and within 12" of each junction box, coupling, outlet or fitting. Support raceway at each 90° degree bend. Support raceway (as it is installed) in accordance with the following:

<u>NUMBER OF RUNS</u>	<u>3/4" TO 1-1/4" Ø</u>	<u>1-1/2" &amp; LARGER Ø</u>
1	Full straps, clamps or hangers.	Hanger
2	Full straps, clamps or hangers.	Mounting Channel
3 or more	Mounting Channel	Mounting Channel

- 2. Support suspended raceways on trapeze hanger systems; or individually by means of threaded rod and straps, clamps, or hangers suitable for the application. Do not use "tie wire" as a portion of any raceway support system; do not support raceway from ceiling support wires.

F. FLOOR MOUNTED EQUIPMENT:

- 1. Provide rigid attachment of all floor mounted equipment to the floor slab or structural system. Provide 5/8" bolts or expansion anchors at each 90 degree corner and at intervals not to exceed 48" on center along entire perimeter of the equipment. Provide rigid attachment for all floor mounted switchboards, panelboards, power and control equipment, motor control centers, dimmer cabinets, transformers (provide neoprene vibrations isolators at anchor points), oil switches, battery packs and racks, and similar equipment furnished under Division 26, 27 and 28.

END OF SECTION 26 0529

## SECTION 26 0532 - CONDUIT RACEWAY

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to electrical raceways and specified herein.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of raceways is indicated by drawings and schedules.
- B. Division-26 is responsible to provide conduit and rough-in for all thermostat controls located within walls. Coordinate with the Controls Contractor and verify exact location of all thermostats. Obtain and review submittals of Temperature Control Equipment from Controls Contractor and Divisions 21-23.
- C. Types of raceways in this section include the following:
  - 1. Electrical Metallic Tubing
  - 2. Flexible Metal Conduit
  - 3. Intermediate Metal Conduit
  - 4. Liquid-tight Flexible Metal Conduit
  - 5. Rigid Metal Conduit
  - 6. Rigid Non-metallic Conduit

#### 1.3 QUALITY ASSURANCE:

- A. MANUFACTURERS: Firms regularly engaged in manufacture of raceway systems of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.
- B. STANDARDS: Comply with applicable portions of NEMA standards pertaining to raceways. Comply with applicable portions of UL safety standards pertaining to electrical raceway systems; and provide products and components that have been UL-listed and labeled. Comply with NEC requirements as applicable to construction and installation of raceway systems.

#### 1.4 SUBMITTALS:

- A. Not Required.

## PART 2 – PRODUCTS

### 2.1 METAL CONDUIT AND TUBING:

#### A. GENERAL:

1. Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) as indicated; with minimum trade size of 3/4".

#### B. RIGID METAL CONDUIT (RMC): FS WW-C-0581 and ANSI C80.1.

#### C. INTERMEDIATE STEEL CONDUIT (IMC): FS WW-C-581.

#### D. PVC EXTERNALLY COATED RIGID STEEL CONDUIT: ANSI C80.1 and NEMA Std. Pub. No. RN 1.

#### E. ALUMINUM CONDUIT: Not acceptable.

#### F. ELECTRICAL NON-METALLIC TUBING (ENT) SYSTEM: Not acceptable.

#### G. MC CABLE: Only acceptable as indicated below.

1. MC Cable is acceptable for all branch circuits installed in gypsum wallboard walls from the home run device box to the last device box on the branch circuit and all boxes in between, from the home run device box to the branch panel, the circuit shall be installed in an approved raceway. **All MC Cable shall be provided with anti-short fittings.**

2. MC Cable is acceptable for all light fixture whips not longer than six feet in length. Located in removable grid ceilings. MC Cable is unacceptable to be installed from light fixture to light fixture. **All MC Cable shall be provided with anti-short fittings.**

- a. The use of MC-PCS cable is acceptable for light fixture whips utilizing 0-10v control schemes, not longer than 72" in length, located above removable grid ceilings. All MC cable shall be provided with anti-short fittings.

#### i. Acceptable Manufacturers

1. AFC – MC Luminary Cable
  2. Encore – MC-LED Lighting Cable
  3. Southwire – MC-PCS Duo
3. Before any rough-in of MC cable, the contractor shall conduct a on-site meeting with owner and engineer to review standards and overall rough-in requirements. Contractor shall conform to all owner and engineer requirements.
  4. Contractor mock-up one classroom for review of electrical installation prior to continuing installation of MC cabling.

#### H. RIGID AND INTERMEDIATE STEEL CONDUIT FITTINGS:

1. Provide fully threaded malleable steel couplings; raintight and concrete tight where required by application. Provide double locknuts and metal bushings at all conduit terminations. Install OZ Type B bushings on conduits 1-1/4" and larger.

#### I. ELECTRICAL METALLIC TUBING (EMT): FS WW-C-563 and ANSI C80.3.



J. EMT FITTINGS:

1. Provide insulated throat nylon bushings with non-indenter type malleable steel fittings at all conduit terminations. Install OZ Type B bushings on conduits 1" larger. Cast or indenter type fittings are not acceptable.

K. FLEXIBLE METAL CONDUIT: FS WW-C-566, of the following type;

1. Zinc-coated steel.

L. FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 1, and Style A.

M. LIQUID TIGHT FLEXIBLE METAL CONDUIT:

1. Provide liquid-tight, flexible metal conduit; constructed of single strip, flexible continuous, interlocked, and double-wrapped steel; galvanized inside and outside; coated with liquid-tight jacket of flexible polyvinyl chloride (PVC).

N. LIQUID-TIGHT FLEXIBLE METAL CONDUIT FITTINGS: FS W-F-406, Type 1, Class 3, Style G.

O. EXPANSION FITTINGS: OZ Type AX, or equivalent to suit application.

2.2 NON-METALLIC CONDUIT AND DUCTS:

A. GENERAL:

1. Provide non-metallic conduit, ducts and fittings of types, sizes and weights as indicated; with minimum trade size of 3/4".

B. PVC AND ABS PLASTIC UTILITIES DUCT FITTINGS:

C. ANSI/NEMA TC 9, match to duct type and material.

D. HDPE CONDUIT: Not acceptable.

2.3 CONDUIT; TUBING; AND DUCT ACCESSORIES:

- A. Provide conduit, tubing and duct accessories of types and sizes, and materials, complying with manufacturer's published product information, that mate and match conduit and tubing. Provide manufactured spacers in all duct bank runs.

2.4 SEALING BUSHINGS:

- A. Provide OZ Type FSK, WSK, or CSMI as required by application. Provide OZ type CSB internal sealing bushings.

2.5 CABLE SUPPORTS:

- A. Provide OZ cable supports for vertical risers, type as required by application.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL RACEWAYS:

- A. Install electrical raceways where indicated; in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA "Standard of Installation", and in accordance with the following:

1. BRANCH CIRCUITS, SIGNAL AND CONTROL CIRCUITS, AND INDIVIDUAL EQUIPMENT CIRCUITS RATED LESS THAN 100 AMPS:
  - a. Install in electric metallic tubing (EMT). Below concrete slab-on-grade or in earth fill, install in non-metallic plastic duct. In areas exposed to weather, moisture, or physical damage, install in RMC or IMC. In suspended slabs, install in EMT (NOT APPROVED).
- B. Coordinate with other work including metal and concrete deck work, as necessary to interface installation of electrical raceways and components.
- C. Install raceway in accordance with the following:
  1. Provide a minimum of 12" clearance measured from outside of insulation from flues, steam and hot water piping, etc. Avoid installing raceways in immediate vicinity of boilers and similar heat emitting equipment. Conceal raceways in finished walls, ceilings and floor (other than slab-on-grade), except in mechanical, electrical and/or communication rooms, conceal all conduit and connections to motors, equipment, and surface mounted cabinets unless exposed work is indicated on the drawings. Run concealed conduits in as direct a line as possible with gradual bends. Where conduit is exposed in mechanical spaces, etc., install parallel with or at right angles to building or room structural lines. Do not install lighting raceway until piping and duct work locations have been determined in order to avoid fixtures being obstructed by overhead equipment.
  2. PVC conduit may be utilized within CMU and Block type walls. At the point exiting or offsetting from wall transition to EMT and metal electrical box as required.
  3. The required raceway size, for any given installation, shall remain the same throughout the entire length of the run. At no point shall any conduit be reduced in size.
  4. Where cutting raceway is necessary, remove all inside and outside burrs; make cuts smooth and square with raceway. Paint all field threads (or portions of raceway where corrosion protection has been damaged) with primer and enamel finish coat to match adjacent raceway surface.
  5. Provide a minimum of 1 ½" from nearest surface of the roof decking to raceway.
  6. In open gymnasiums, auditoriums, etc; all conduit shall be installed in straight lines parallel to, or at right angles to, the structure or adjacent building elements. Separations between conduits and fastenings of conduits shall be neat and consistent. Conduit shall be installed as tight to the bottom of structural elements when parallel to joists as code will allow. Overall installation shall be accomplished in an aesthetic and workmanlike manner. No conduits shall be allowed to run perpendicular to the bottom chord and at the bottom of the joists.
  7. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling. No exposed cables shall be seen from below.
  8. Provide a maximum of three phase conductors in any one conduit or as approved by electrical engineer. Where phase conductors share a common neutral they must have a means to simultaneously disconnect all ungrounded conductors at

- the point where the branch circuits originate. The ungrounded and neutral conductors of a multi-wire branch circuit must be grouped together by wire ties at the point of origination.
9. Provide neutral and ground wire as specified elsewhere in documents.
  10. Provide separate neutral conductor for all single phase branch circuits installed. No shared neutrals are allowed. Neutral conductor shall be the same size as the phase conductor.
- D. Comply with NEC for requirements for installation of pull boxes in long runs.
  - E. Cap open ends of conduits and protect other raceways as required against accumulation of dirt and debris. Pull a mandrel and swab through all conduit before installing conductors. Install a 200 lb. nylon pull cord in each empty conduit run.
  - F. Replace all crushed, wrinkled or deformed raceway before installing conductors.
  - G. Do not use flame type devices as a heat application to bend PVC conduit. Use a heating device that supplies uniform heat over the entire area without scorching the conduit.
  - H. Provide rigid metal conduit (RMC) for all bends greater than 22 degrees in buried conduit. Provide protective coating for RMC bend as specified herein.
  - I. Where raceways penetrate building, area ways, manholes or vault walls and floors below grade, install rigid metal conduit (RMC) for a minimum distance of 10 feet on the exterior side of the floor or wall measured from interior face. Provide OZ, Type FSK, WSK or CSMI sealing bushings (with external membrane clamps as applicable) for all conduit penetrations entering walls or slabs below grade. Provide segmented type CSB internal sealing bushings in all raceways penetrating building walls and slabs below grade, and in all above grade raceway penetrations susceptible to moisture migration into building through raceway.
  - J. Install liquid-tight flexible conduit for connection of motors, transformers, and other electrical equipment where subject to movement and vibration.
  - K. Install spare 3/4" conduits (capped) from each branch panelboard into the ceiling and floor space. Run five into the ceiling space and five into the floor space. Where the floor is not accessible run six conduits into the ceiling space. Run conduits the required distance necessary to reach accessible ceiling space.
  - L. Provide OZ expansion fittings on all conduits crossing building expansion joints, both in slab and suspended.
  - M. Provide OZ cable supports in all vertical risers in accordance with NEC 300-19; type as required by application.
  - N. Complete installation of electrical raceways before starting installation of cables/conductors within raceways.
  - O. Raceway installation below grade:
    1. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.

2. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
- P. Raceway installation below slab-on-grade, or below grade:
1. For slab-on-grade construction, install runs of rigid plastic conduit (PVC) below slab. All raceway shall be located a at top of sub-grade and a minimum of 6" below bottom of slab. Stake down conduits as required to keep conduits from floating or moving. Coordinate strictly with other trades at grade level structural members for correct installation. Install RMC (with protective coating) for raceways passing vertically through slab-on-grade. Slope raceways as required to drain away from electrical enclosures and to avoid collection of moisture in raceway low points.
  2. Apply protective coating to metallic raceways in direct contact with earth or fill of any type; consisting of spirally wrapped PVC tape (1/2" minimum overlap of scotch wrap tape or equal); or factory applied vinyl cladding (minimum thickness .020 inches). Completely wrap and tape all field joints.
  3. Mark all buried conduits that do not require concrete encasement by placing yellow plastic marker tape (minimum 6" wide) along entire length of run 12" below final grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16", install a single line marker.
  4. Burial depths must comply with NEC Section 300-5 but in no case be less than 24", unless noted otherwise on drawings.
  5. Do not locate utility feeds under any structure. Verify all utility power paths with RMP prior to any rough-in. Utility burial depths must comply with RMP requirements or AHJ, but in no case be less than 48" minimum, unless noted otherwise on drawings, diagrams etc.
- Q. Raceway installation in suspended slabs:
1. No conduit can be installed in suspended slabs.
- R. Raceway installation in hazardous locations:
1. Install RMC in all hazardous locations as defined by NEC. Provide suitable fittings, seal-offs, boxes, etc. to comply with requirements.
  2. Engage at least five full threads on all fittings. Provide inspection fittings with explosion proof drains to prevent water accumulation in conduit runs. Install seal-offs for arcing or high temperature equipment, at housing with splices or taps and where conduits enter or leave the hazardous area. Provide seal-offs of the appropriate type for vertical or horizontal installation. Ground all metallic parts.
- S. Electrical Identification: Refer to Section 260553 for requirements.

END OF SECTION 26 0532

## SECTION 26 0533 - ELECTRICAL BOXES AND FITTINGS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is a part of each Division-26, 27 and 28 section making reference to electrical wiring boxes and fittings specified herein. See Section 260532, Raceways, for additional requirements.

#### 1.2 DESCRIPTION OF WORK:

- A. The extent of electrical box and electrical fitting work is indicated by drawings and schedules.
- B. Types of electrical boxes and fittings in this section include the following:
  - 1. Outlet Boxes
  - 2. Junction Boxes
  - 3. Pull Boxes
  - 4. Floor Boxes
  - 5. Conduit Bodies
  - 6. Bushings
  - 7. Locknuts
  - 8. Knockout Closures
  - 9. Miscellaneous Boxes and Fittings

#### 1.3 QUALITY ASSURANCE:

- A. Comply with NEC as applicable to construction and installation of electrical boxes and fittings. Comply with ANSI C 134,1 (NEMA Standards Pub No. OS 1) as applicable to sheet-steel outlet boxes, device boxes, covers and box supports. Provide electrical boxes and fittings that have been UL-listed and labeled.

#### 1.4 SUBMITTALS:

- A. Submit manufacturer's data including specifications, installation instruction and general recommendations for each type of floor box used on project.

### PART 2 - PRODUCTS

#### 2.1 FABRICATED MATERIALS:

- A. INTERIOR OUTLET BOXES:
  - 1. Provide one piece, galvanized flat rolled sheet steel interior outlet wiring boxes with accessory rings, of types, shapes and sizes, including box depths, to suit

each respective location and installation, construct with stamped knockouts in back and sides, and with threaded screw holes with corrosion-resistant screws for securing box and covers and wiring devices; minimum size 4"x4"x2-1/8".

2. Provide an 'FS' box, with no knockouts when surface mounted in a finished, non-utility space. Surface mounting is only acceptable when approved by the Architect.

**B. INTERIOR OUTLET BOX ACCESSORIES:**

1. Provide outlet box accessories as required for each installation, including mounting brackets, hangers, extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, that are compatible with outlet boxes being used and fulfilling requirements of individual wiring applications.

**C. WEATHERPROOF OUTLET BOXES:**

1. Provide corrosion-resistant cast-metal weatherproof outlet wiring boxes, of types, shapes and sizes (including depth) required, with threaded conduit ends, cast-metal face plates with spring-hinged waterproof caps suitably configured for each application, with face plate gaskets and corrosion-resistant fasteners.

**D. JUNCTION AND PULL BOXES:**

1. Provide code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes to suit each respective location and installation; with welded seams and equipped with stainless steel nuts, bolts, screws and washers.

**E. CONDUIT BODIES:**

1. Provide galvanized cast-metal conduit bodies, of types, shapes and sizes to suit respective locations and installation, construct with threaded-conduit-entrance ends, removable covers, and corrosion-resistant screws.

**F. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS:**

1. Provide corrosion-resistant punched-steel box knockout closures, conduit locknuts and malleable steel conduit bushings and offset connectors, of types and sizes to suit respective uses and installation.

**PART 3 - EXECUTION**

**3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS:**

**A. GENERAL:**

1. Install electrical boxes and fittings where indicated, complying with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.
2. Coordinate installation of electrical boxes and fittings with wire/cable and raceway installation work.
3. Provide coverplates for all boxes. See Section 262726, Wiring Devices.
4. Provide weatherproof outlets for interior and exterior locations exposed to weather or moisture.

5. Provide knockout closures to cap unused knockout holes where blanks have been removed.
6. Install boxes and conduit bodies to ensure ready accessibility of electrical wiring. Do not install boxes above ducts or behind equipment. Install recessed boxes with face of box or ring flush with adjacent surface. Seal between switch, receptacle and other outlet box openings and adjacent surfaces with plaster, grout, or similar suitable material.
7. Fasten boxes rigidly to substrates or structural surfaces, or solidly embed electrical boxes in concrete or masonry. Use bar hangers for stud construction. Use of nails for securing boxes is prohibited. Set boxes on opposite sides of common wall with minimum 10" of conduit between them. Set boxes on opposite sides of fire resistant walls with minimum of 24" separation.
8. Provide a minimum of 1 ½" from the nearest surface of the roof decking to the installed boxes.
9. Provide electrical connections for installed boxes.

END OF SECTION 26 0533

BLANK PAGE



## SECTION 26 0553 - ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Requirements of the following Division 26 Sections apply to this section:
  - 1. “Basic Electrical Requirements”.
  - 2. “Basic Electrical Materials and Methods”.

#### 1.2 SUMMARY

- A. This section includes identification of electrical materials, equipment and installations. It includes requirements for electrical identification components including but not limited to the following:
  - 1. Buried electrical line warnings.
  - 2. Identification labels for raceways, cables and conductors.
  - 3. Operational instruction signs.
  - 4. Warning and caution signs.
  - 5. Equipment labels and signs.
  - 6. Arc-flash hazard labels
- B. Related Sections: The following sections contain requirements that relate to this section:
- C. Division 9 Section “Painting” for related identification requirements.
- D. Refer to other Division 26 sections for additional specific electrical identification associated with specific items.

#### 1.3 QUALITY ASSURANCE

- A. Electrical Component Standard: Components and installation shall comply with NFPA 70 “National Electrical Code”

#### 1.4 SUBMITTALS: Refer to Section 26 0503 for requirements.

### PART 2 – PRODUCTS

#### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
  - 1. American Labelmark Co.
  - 2. Calpico, Inc.
  - 3. Cole-Flex Corp.
  - 4. Emed Co., Inc.

5. George-Ingraham Corp.
6. Ideal Industries, Inc.
7. Kraftbilt
8. LEM Products, Inc.
9. Markal Corp
10. National Band and Tag Co.
11. Panduit Corp.
12. Radar Engineers Div., EPIC Corp.
13. Seton Name Plate Co.
14. Standard Signs, Inc.
15. W.H Brady, Co.

## 2.2 ELECTRICAL IDENTIFICATION PRODUCTS

- A. Colored Conduit Systems for raceway identification:
  1. Factory-painted conduit and/or factory-painted couplings and fittings
- B. Colored paint for raceway identification:
  1. Use [Kwal Paint](#) colors as specified in Part 3 – Execution.
- C. Color Adhesive Marking Tape for Raceways, Wires and Cables:
  1. Self-adhesive vinyl tape not less than 3 mills thick by 1” to 2” in width.
- D. Underground Line Detectable Marking Tape:
  1. Permanent, bright colored, continuous-printed, acid- and alkali-resistant plastic tape specifically compounded for direct-burial service. Not less than 6” wide by 4 mills thick.
  2. With metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep.
  3. Printed legend indicative of general type of underground line below.
- E. Wire/Cable Designation Tape Markers:
  1. Vinyl or vinyl-cloth, self-adhesive, wraparound, cable/conductor markers with pre-printed numbers and letters.
- F. Brass or Aluminum Tags:
  1. Metal tags with stamped legend, punched for fastener.
  2. Dimensions: 2” X 2” 19 gage.
- G. Engraved, Plastic Laminated Labels, Signs and Instruction Plates:
  1. Engraving stock plastic laminate, 1/16” minimum thickness for signs up to 20 sq. in. or 8” in length; 1/8 “ thick for larger sizes. Engraved legend in 1/4” high white letters on black face and punched for mechanical fasteners.
- H. Arc-flash Hazard Labels:
  1. ANSI Z535.4 Safety Label.

2. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
  3. Dimensions: 5" x 3.5"
  4. Information contained: Arc-flash boundary; Voltage; Flash Hazard Category; Incident Energy (arc rating); checkboxes for the required Personal Protective Equipment (PPE) and the date that the calculations were performed.
- I. Equipment Labels:
1. Adhesive backed polyester with self-laminating flap. Chemical, abrasion and heat resistant.
  2. Dimensions: minimum 5" x 2"
  3. Conductor-Identification-Means Labels:
    - a. Information contained: the method utilized for identifying ungrounded conductors within switchboards, distribution panels and branch circuit panels.
  4. Available-Fault-Current Labels:
    - a. Information contained: maximum available fault current at the respective piece of equipment, and date of calculation of fault current.
  5. Source-of-Supply Labels:
    - a. Information contained: indicate the device or equipment where the power supply originates.
- J. Baked Enamel Warning and Caution Signs for Interior Use:
1. Preprinted aluminum signs, punched for fasteners, with colors legend and size appropriate to location.
- K. Fasteners for Plastic-Laminated and Metal Signs:
1. Self-tapping stainless steel screws or # 10/32 stainless steel machine screws with nuts, flat and lock washers.
- L. Cable Ties:
1. Fungus-inert, self-extinguishing, one-piece, self-locking nylon cable ties, 0.18" minimum width, 50-lb. Minimum tensile strength, and suitable for a temperature range from minus 40° F. to 185° F. Provide ties for specified colors when used for color coding.
- M. Colored Support Wires:
1. When electrical equipment/wiring is supported by wires within the ceiling cavity, these wires shall be independent of the ceiling support assembly and shall be distinguishable by painting entire length in bright yellow.

## PART 3 – EXECUTION

### 3.1 INSTALLATION

#### A. Lettering and Graphics:

1. Coordinate names, abbreviations, colors and other designations used in electrical identification work with corresponding designations specified or indicated.

Install numbers, lettering and colors as approved in submittals and as required by code.

B. Install identification devices in accordance with manufacturer's written instructions and requirements of NEC.

C. Sequence of Work:

1. Where identification is to be applied to surfaces that require a finish, install identification after completion of finish work.

D. Conduit Identification:

1. Identify Raceways of Certain Systems with Color Coding. Acceptable means of color identification are as follows:

a. Factory-painted conduit.

b. Band exposed or accessible raceways of the following systems for identification. Bands shall be pre-tensioned, snap-around colored plastic sleeves, colored adhesive marking tape, or a combination of the two. Make each color band 2 inches wide, completely encircling conduit, and place adjacent bands of two-color markings in contact, side by side. Install bands at changes in direction, at penetrations of walls and floors, and at 40-foot maximum intervals in straight runs. Apply the following colors:

i. Fire Alarm System: Red

ii. Sound/IC: Yellow

iii. Data: Blue

iv. MATV: Black

v. Security: Orange

vi. Legally Required Emergency Systems: Red with Black Stripe (Per NEC 700.10(A))

2. Identify Junction, Pull and Connection Boxes.

a. Code-required caution sign for boxes shall be pressure-sensitive, self-adhesive label indication system voltage in black, preprinted on orange background. Install on outside of box cover. Also label box covers on outside of cover with identity of contained circuits. Use pressure-sensitive plastic labels at exposed locations and similar labels or plasticized card stock tags at concealed boxes.

3. Label and paint the covers of the systems junction boxes as follows:

SYSTEM	COLOR (ALL COLORS ARE <a href="#">KWAL PAINT</a> )	
Fire Alarm	Red Alert	AC118R
Sound/IC	Competition Yellow	7225A
Security	Fiesta Orange	AC107Y
Data	Neon Blue	7076A
MATV	Flat Black	
Legally	Red/Black Stripe	

Required EM System		
-----------------------	--	--

E. Underground Electrical Line Identification.

1. During trench backfilling, for exterior underground power, signal, and communications lines, install continuous underground line detectable marking tape, located directly above line at 6 to 8 inches below finished grade. Where multiple lines are installed in a common trench or concrete envelope, do not exceed an overall width of 16 inches; install a single line marker.
2. Install detectable marking tape for all underground wiring, both direct-buried and in raceway.
3. Provide red marker dye applied to concrete encased ductbank.

F. Conductor Color Coding.

1. Provide color coding for secondary service, feeder and branch circuit conductors throughout the project secondary electrical system as follows:

<u>CONDUCTOR</u>	<u>208Y / 120V System</u>	<u>480Y / 277V System</u>
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow
Shared/Single Neutral	White	Gray
Neutral A (dedicated)	White w/Black Stripe	Gray w/Black Stripe
Neutral B (dedicated)	White w/Red Stripe	Gray w/Orange Stipe
Neutral C (dedicated)	White w/Blue Stripe	Gray w/Yellow Stipe
Equipment Ground	Green	Green
Isolated Ground	Green w/Yellow Strip	Green w/Yellow Stripe

2. Switch legs, travelers and other wiring for branch circuits shall be of colors other than those listed above.
3. Use conductors with color factory applied the entire length of the conductors except as follows:
  - a. The following field-applied color-coding methods may be used in lieu of factory-coded wire for sizes larger than No. 10 AWG.
  - b. Apply colored, pressure-sensitive plastic tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Use 1-inch-wide tape in colors as specified. Do not obliterate cable identification markings by taping. Tape locations may be adjusted slightly to prevent such obliteration.
  - c. In lieu of pressure-sensitive tape, colored cable ties may be used for color identification. Apply three ties of specified color to each wire at each terminal or splice point starting 3 inches from the terminal and

spaced 3 inches apart. Apply with a special tool or pliers, tighten for snug fit, and cut off excess length.

G. Power Circuit Identification.

1. Securely fasten identifying metal tags or aluminum wraparound marker bands to cables, feeders, and power circuits in vaults, pull boxes, junction boxes, manholes, and switchboard rooms with 1/4-inch steel letter and number stamps with legend to correspond with designations on Drawings. If metal tags are provided, attach them with approximately 55-lb monofilament line or one-piece self-locking nylon cable ties.
2. Tag or label conductors as follows:
  - a. Future Connections: Conductors indicated to be for future connection or connection under another contract with identification indicating source and circuit numbers.
  - b. Multiple Circuits: Where multiple branch circuits or control wiring or communications/ signal conductors are present in the same box or enclosure (except for three-circuit, four-wire home runs), label each conductor or cable. Provide legend indicating source, voltage, circuit number, and phase for branch circuit wiring. Phase and voltage of branch circuit wiring may be indicated by mean of coded color of conductor insulation. For control and communications/signal wiring, use color coding or wire/cable marking tape at terminations and at intermediate locations where conductors appear in wiring boxes, troughs, and control cabinets. Use consistent letter/number conductor designations throughout on wire/cable marking tapes.
3. Match identification markings with designations used in panelboards shop drawings, Contract Documents, and similar previously established identification schemes for the facility's electrical installations.

H. Apply warning, caution and instruction signs and stencils as follows:

1. Install warning, caution, or instruction signs where required by NEC, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems and of the items they connect. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system or equipment operation. Install butyrate signs with metal backing for outdoor items. Warning and caution signs shall be furnished and installed on, but not be limited to the following equipment and locations:
  - a. Entrances to rooms and other guarded locations that contain exposed live parts 600 volts or less; signs shall forbid unqualified personnel to enter.
  - b. Switch and Overcurrent device enclosures with splices, taps and feed-through conductors. Provide warning label on the enclosures that identifies the nearest disconnecting means for any feed-through conductors.
  - c. Entrances to buildings, vaults, rooms or enclosures containing exposed live parts or exposed conductors operating at over 600 volts: DANGER-HIGH VOLTAGE-KEEP OUT.

- d. Metal-enclosed switchgear, unit substations, transformers, enclosures, pull boxes, connection boxes and similar equipment operating at over 600 volts shall have appropriate caution signs and warning labels.
  - e. Indoor and Outdoor substations operating over 600 volts. Provide warning signs, instructional signs and single-line diagrams in accordance with NEC 225.70.
- I. Emergency Operating Signs: Install engraved laminated signs with white legend on red background with minimum 3/8-inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.
- J. Install equipment/system circuit/device identification as follows:
  - 1. Apply equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes communication/signal/alarm systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/4"-high lettering on 1-inch-high label (1 1/2-inch-high where two lines are required) white lettering in black field. White lettering in red field for Emergency Power Systems. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each unit of the following categories of electrical equipment.
    - a. Each service disconnect, to identify it as a service disconnect.
    - b. Panelboards (exterior and interior), electrical cabinets, and enclosures. For subpanels, identify feeder circuit served from.
    - c. Switches in fusible panelboards shall be labeled. Main switches shall be identified.
    - d. Access doors and panels for concealed electrical items.
    - e. Electrical switchgear and switchboards.
    - f. Motor control centers.
    - g. Motor starters, including circuit origination, HP, heater size, FLA, and mechanical equipment designation.
    - h. Disconnect switches.
    - i. Pushbutton stations.
    - j. Power transfer equipment.
    - k. Contactors.
    - l. Dimmers.
    - m. Control devices.
    - n. Transformers.
    - o. Power generating units, to include transfer switches.
    - p. Telephone switching equipment.
    - q. Clock/program master equipment.
    - r. Call system master station.
    - s. TV/audio monitoring master station.

- t. Fire alarm master station or control panel.
  - u. Busduct – Label all cable tap boxes, bus plug-in units, etc. with plastic laminate labels designating load served.
  - v. Variable frequency drives.
  - w. Lighting Control Equipment.
  - x. Uninterruptable Power Supply.
- K. Post Conductor-Identification-Means labels at locations of switchboards, distribution panels and branch circuit panels. The labels shall identify the color-coding used on ungrounded conductors for each voltage system used on the premises.
- L. Apply Available-Fault-Current labels at the service entrance equipment.
- M. Apply Source-of-Supply labels on the exterior covers of equipment (except in single- or two-family dwellings) as follows:
  - 1. Each switchboard supplied by a feeder.
  - 2. Each branch circuit panelboard supplied by a feeder.
  - 3. Each disconnect switch serving elevators, escalators, moving walks, chairlifts, platform lifts and dumbwaiters.
  - 4. Each dry type transformer (or primary-side disconnect switch at transformer). If the primary-side disconnect is remote from the transformer, both the remote disconnect and the transformer shall be labeled, and the transformer label shall also indicate the location of the disconnect.
  - 5. Each feeder disconnect, branch circuit disconnect, panelboard or switchboard in a remote building or structure.
  - 6. Each on-site emergency power source, with sign placed at service entrance equipment to comply with NEC 700.
- N. The label shall identify the device or equipment where the power supply originates, and the system voltage, phase or line and system at all termination, connection and splice points. For example: Feeder Power Supply for Panel “XX” Originates at Panel “XX” (or Switchboard “XX”, Transformer “XX”, Switch “XX”, etc.); 120/208 volts, 3-phase, Phase Color Identification (or 120/240, 277/480, etc.).
- O. Install Arc-flash hazard labels on the following equipment:
  - 1. Each piece of service entrance equipment.
  - 2. Each power distribution switchboard or panel.
  - 3. Each individually mounted circuit breaker.
  - 4. Each branch circuit panelboard.
  - 5. Each motor control center.
  - 6. Each individually mounted motor starter.
  - 7. Each meter socket enclosure.
- P. Apply circuit/control/item designation labels of engraved plastic laminate for disconnect switches, breakers, pushbuttons, pilot lights, motor control centers, and similar items for power distribution and control components above, except panelboards and alarm/signal components, where labeling is specified elsewhere.



- Q. Install labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.
- R. Engrave all receptacle plates other than those serving 120 volt, single phase devices. State voltage and amperage characteristics: Example; "208V 30A".
- S. Mark each device box (for each type of wiring device) with a permanent ink felt tip marker, indicating the circuit that the device is connected to: Example; "CKT A-1"
- T. Label circuit breaker feeding fire alarm panel "Fire Alarm Circuit". Using plastic laminate label, white lettering on a red background.

END OF SECTION 26 0553

BLANK PAGE

## SECTION 26 0943 - LIGHTING CONTROL EQUIPMENT

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of lighting control equipment work is indicated by drawings and schedules, and is hereby defined to include, but not by way of limitation, lighting control panels, control stations and other user interface devices, wiring and ancillary equipment.
- B. Types of lighting control equipment specified in this section, includes the following:
  - 1. Low voltage relay control panels
  - 2. Occupancy sensors
  - 3. Daylight sensors
  - 4. Wallstations/Switches
  - 5. Lighting Load Controllers (Room Controllers)
  - 6. Emergency Lighting Control Units/Generator Transfer Devices
- C. Requirements are indicated elsewhere in these specifications for work including but not limited to raceways, electrical boxes and fittings required for installation of lighting control equipment, not work of this section.

#### 1.3 QUALITY ASSURANCE:

- A. Manufacturers: Firms regularly engaged in manufacture of lighting control equipment and ancillary equipment, of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. To ensure a uniform installation and single responsibility, all switching and dimming equipment described herein shall be supplied by a single manufacturer.
- B. Installer: Qualified with at least 3 years of successful installation experience on projects with lighting control equipment installation work similar to that required for project.
- C. NEC Compliance: The control system shall comply with all applicable National Electrical Codes regarding electrical wiring standards.
- D. NEMA Compliance: The control system shall comply with all applicable portions of the NEMA Standard regarding the types of electrical equipment enclosure.

- E. Codes and Standards: Provide units that meet the requirements of IEEE Std. 2000.1.1999.
- F. Independent Testing Laboratory: Provide units that have been tested and listed under UL 916 energy management equipment.
- G. Component Pre-testing: All control equipment shall undergo strict inspection standards. The equipment shall be previously tested and burned-in at the factory prior to installation.

#### 1.4 SUBMITTALS:

- A. Refer to Section 26 0502 for electrical submittal requirements.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide lighting control equipment of one of the following;
  - 1. Acuity nLight Controls
- B. The lighting controls as shown are based upon existing nLight lighting controls. Prior approval and commitment to being able to provide similar and equal system is required before bidding this project. Rework and provide new components as required to provide a complete and working system.
- C. Manufacturer's representative for division 26 and bidding controls shall be accountable for the comprehensive lighting controls package's finalization in alignment with the design intent depicted in the drawings and complying with IECC 2021 requirements. The lighting representative is required to develop detailed shop drawings demonstrating the lighting control system's topology and the essential connections necessary for its proper functioning. Lighting control devices shown are to provide general intent only. Manufacturers representative to provide all additional devices and modify device locations as required to meet IEC 2021 requirements
- D.

#### 2.2 SYSTEM DESCRIPTION:

- A. The lighting control system shall provide seamless control and monitoring of all lighting included in the scope of work regardless of whether it is relay switched or dimmed.
- B. The lighting control system shall consist of low voltage relay control panels with programmable switch inputs, the panel shall be microprocessor controlled with a touchscreen interface display. The touchscreen shall provide relay status information viewable through a protected windowed enclosure. All local programming shall be permissible through the self-prompting touchscreen.
- C. Programmable intelligence shall include:
  - 1. Time of day control (64 time-of-day/holiday schedules)
  - 2. 32 holiday dates
  - 3. Timed inputs (adjustable from 1 to 99 minutes)

4. Timed override (from touchscreen, adjustable from 1 to 999 minutes, then resumes normal schedule)
  5. Pre-set controls
  6. Auto daylight savings adjust
  7. Low voltage Dimming/Central Dimming Controls:
    - a. 0-10V dimming capability
    - b. Daylighting control via 0-10V dimming relays and programming
    - c. DMX or other dimming protocols as indicated on plans
  8. Astronomical clock with offsets
  9. Local control (from touchscreen and local switch)
  10. Digital wallstations/switches
  11. Flash warning of impending off for occupants
  12. Network override
- D. The controller shall permit lighting to be overridden on for after-hours use or cleaning. The controller shall provide priority and masking choices to allow for customizing the functions of switch inputs, thereby enabling wallstations/switches to function differently at different times of day. These overrides shall be digital, network or hard-wired inputs.
- E. The lighting control system shall be fully programmable through PC programming software. Programming shall be permitted through a direct RS-232 connection, modem or TCP/IP.
1. Shall include with user-friendly software suitable for operation on computer workstations which serve as central control stations for the selection and operation of lighting scenes.
  2. All software shall be programed by the vendor and delivered ready to use. This program shall include preparation of all graphics, and displays required as a part of this project.
- F. The control system shall provide networking between lighting control panels. The network shall support up to a maximum of 254 control panels. Panels shall permit data sharing for global controls. All inputs shall be transferable over the network to create any switching pattern.
- G. The lighting control system shall log all control events. Log reports shall be available through the integral touchscreen or enterprise software.
- H. All lighting programing shall meet the requirements of the IECC 2018 or current energy code applied to the project.

## 2.3 EQUIPMENT:

- A. Room Controllers:
1. The room controller shall provide the following functionality;

- a. Provide interface with room occupancy sensor to provide lighting and receptacle control and be programmable as either manual on/automatic off. Provide interface with room wallstations to provide multi-level switching and/or variable dimming. Provide interface with daylight sensors to provide daylighting controls of lighting fixture via multi-level (step dimming) and/or variable dimming.
2. The room controller shall be a fully functional lighting control system to match the room lighting and control requirements. The controller shall provide the following features:
  - a. Separate compartments for line voltage, emergency voltage and low voltage connections.
  - b. Breakouts for direct conduit connections.
  - c. Dual voltage (120/277 VAC)
  - d. Low voltage connections using standard RJ-45 connectors.
  - e. Zero cross circuitry for each load.
  - f. Relay and 0-10V dimming zone configuration to match room requirements.
  - g. The ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.
3. Emergency Lighting: When the room controller is provided with emergency relay, the controller shall be UL 924 Listed and monitor the normal power circuit. The UL 924 relay will track the normal power operation. Upon loss of normal power the emergency lighting will be forced on to full bright (if dimming) until normal power is restored. The following features shall be included:
  - a. 120/277 VAC
  - b. Push-to-test
4. Daylight sensors shall work with the room controller to provide automatic daylight dimming capabilities for loads connected to the room controller. The daylight sensor shall include the following features:
  - a. An additional photodiode that measures only the visible spectrum.
  - b. The sensor shall have three light level ranges;
    - i. Low (3-300 LUX), high (30-3000 LUX) and direct sun (300-30,000 LUX).
  - c. The sensor shall provide the capability of controlling multiple (up to three) daylight zones for dimming daylight harvesting.
  - d. The sensor shall include an internal photodiode that measures light in a 60 degree angle cutting off the unwanted light from the interior of the room.
5. Ceiling Mounted Occupancy Sensors: Sensors shall utilize dual-technology (ultrasonic and infrared technologies) and have the following additional features:
  - a. Sensor shall be class 2, low voltage; capable of mounting in the ceiling

- for maximum coverage.
  - b. Sensor shall have automatic self-adjustment algorithm that adjusts timer and sensitivity settings to maximize performance and minimize energy usage.
  - c. Sensor shall have 360 degree field of view.
  - d. Sensor shall incorporate non-volatile memory such that all settings and parameters are saved in protected memory.
  - e. Sensor shall have time delays from 10 to 30 minutes.
  - f. Sensor shall provide a visual means of indication that motion is being detected via an LED.
  - g. Sensors shall have readily accessible, user adjustable settings for time delay and sensitivity.
  - h. Provide internal additional isolated relay with NO, NC and common outputs for use with HVAC control, data logging and other control options.
- 6. Wallstations: Provide low voltage push-button type switches up to 8 button configurations to match requirements of lighting control within the room. Provide factory engraved labeling for individual push buttons. Provide in a color to match wiring devices and coverplates to match devices and plates in Wiring Devices (Section 26 2726). Wallstation shall connect to the room controller via the room controller local network. Wallstations that require user interface to allow for raise/lower control of dimming, loads shall include a slider function or similar. All wallstations shall have the ability to be independently program or be re-programmed on site and without the need to replace or send the device to the manufacturer for re-programming.
- B. Emergency Power Control (CEPC)/ Emergency Lighting Control Units (ELCU)/Generator Transfer Devices (Required when not built into Room Controller, Relay Panel, etc):
  - 1. The Emergency Power Control (CEPC)/Lighting Control Unit (ELCU) shall provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building. The unit shall be installed flush to the ceiling so that test switch & LED's are in plain view of room occupants as required by some local electrical codes.
  - 2. The device shall automatically illuminate connected emergency loads upon utility power interruption, regardless of room switch position. (NEC 700.24)
  - 3. Local room switch or lighting control shall turn both regular & emergency luminaires on at the same time (no dedicated emergency room switch required).
  - 4. The emergency lighting control unit shall allow control of emergency lighting fixtures in tandem with normal lighting in an area while ensuring that emergency lighting will turn on immediately to full brightness upon loss of normal power

supplying the control device. Emergency lighting operation shall be independent for each controlled area and shall not require a generalized power failure for proper operation.

5. The unit shall be compatible with 2-wire, 3-wire, 0-10V, & DALI dimming systems & ballasts.
6. The device shall be self-contained, measure 1.70" x 2.97" x 1.64," and provide integral one half inch pip nipple mount with snap in locking feature for mounting into a standard junction box KO.
7. The device shall have normally closed dry contacts capable of switching 20 amp emergency ballast loads @ 120-277 VAC, 60 Hz, or 10 amp tungsten loads @ 120 VAC, 60 Hz.
8. The device shall have universal rated voltage inputs provided for normal power sense and normal switched power at 120-277 VAC, 60 Hz.
9. The device shall have an integral momentary test switch. Pressing and holding this switch shall instantly force the unit into emergency mode and turn on emergency lighting. Releasing the test switch shall immediately return the unit to normal operation.
10. The unit shall provide dedicated leads and 24 VDC source for connection to remote test switch, fire alarm system, or other external system capable of providing a normally closed dry contact closure. Breaking contact between the terminals shall force and hold the emergency lighting on until the terminals are again closed. An integral LED indicator shall indicate the unit's current remote activation status.
11. The device shall provide separate LEDs to indicate the presence of normal and emergency power sources. The LEDs shall indicate the unit's current operational mode (normal or emergency).
12. The device's normal power input lead shall be connected to the line side of the control device such that any upstream fault causing a loss of power, including the tripping of the branch circuit breaker, will force the unit into the emergency mode and turn on the emergency lighting.
13. The unit shall automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, the unit shall force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
14. The unit shall utilize zero crossing circuitry to protect relay contacts from the damaging effects of inrush current generated by switching electronic ballast loads.



15. The unit shall have UL 94-V0 or UL 94-5VA flame rating & be approved for installation above the suspended ceiling.
16. To ensure quality and reliability, the unit shall be manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1%.
17. The device shall not generate any objectionable electrical or mechanical noise.
18. The unit shall be UL and cUL listed and labeled for connection to both normal and emergency lighting power sources.

C. Interface and Accessories (Classroom Touch Screen and Shade Controller Interface):

1. Provide serial data interface that connects to the room controllers local network to a third-party system for coordinated control of devices including lighting controls, AV equipment (Touch Screen and Processor), shade controls and user interfaces by either system.
  - a. Provide manufacturer capable communication devices capable of communicating via standard protocols – RS-232, RS-485 and Ethernet (Preferred Method).
2. Program shades, per owner's requirements, to operate in accordance with the defined lighting presets within the space.

PART 3 - EXECUTION:

3.1 INSTALLATION OF LIGHTING CONTROL EQUIPMENT:

- A. Install lighting control system components and ancillary equipment as indicated, in accordance with equipment manufacturers written instructions, and with recognized industry practices, to ensure that lighting control equipment complies with requirements.
- B. Comply with Requirements of NEC, and applicable portions of NECA's 'Standard of Installation' pertaining to general electrical installation practices.
- C. Coordinate with other electrical work, including raceways, electrical boxes and fittings, as necessary to interface installation of lighting control equipment work with other work.
- D. Electrical Identification: Refer to Section 26 0553 for requirements.

3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation and after circuitry has been energized, demonstrate capability and compliance of system with requirements.
- B. Where possible, correct malfunctioning units at site, then retest to demonstrate

compliance; otherwise, remove and replace with new units, and proceed with retesting.

### 3.3 PRODUCT SUPPORT AND SERVICES:

- A. System Start-Up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:
  - 1. The control system has been fully installed in accordance with manufacturer's installation instructions.
  - 2. Low voltage wiring for overrides and sensors is completed.
  - 3. Accurate 'as-built' load schedules have been prepared for each lighting control panel.
  - 4. Proper notification of the impending start-up has been provided to the owner's representative.
  - 5. Programming of all wallstations/switches, relays, groups of relays and interfaces with building automation shall be completed by factory authorized technician, prior to final and training.
- B. Factory support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll free number for technical support.

### 3.4 PROGRAMMING:

- A. Program of all lighting control systems as directed by the electrical engineer and/or owner. Meet with the electrical engineer at their office prior to preparation of shop drawings to discuss specific programming and zoning requirements of system(s). Each networked or standalone system shall be programmed to revert back to its normal "ON" position one hour after selecting a scene or raising or lowering a lighting zone.
- B. All lighting programing shall meet the requirements of the IECC 2018 or current energy code applied to the project.
- C. Integrate lighting controls into classroom or room AV touch Screen and Shade Controller. Provide interface as required. Coordinate with AV integrator to integrate with Touch Panel and GUI within the room. Lighting shall provide multiple presets and slider control options.
  - 1. Sensors can be used to trigger automated settings for shades and projector screens based on room occupancy, ambient light level, etc.
  - 2. Program lighting and shades, per owner's requirements, to operate in accordance with the defined lighting presets within the space.

### 3.5 COMMISSIONING:

- A. A lighting control system requires at least one site visit for proper commissioning. If

multiple site visits are required, the first ensures that the contractor is trained to install the system correctly. On the second, the factory trained engineer will start up the system, ensure that it is operating according to specification, and perform initial programming. The third visit is for the purposes of refining the programming, and training the owner/end user on the system.

B. Provide factory-certified field service engineer to ensure proper system installation and operation under following parameters:

1. Certified by the equipment manufacturer on the system installed.
2. Site visit activities:
  - a. Verify connection of power feeds and load circuits.
  - b. Verify connection of controls.
  - c. Verify system operation control by control, circuit by circuit.
  - d. Obtain sign-off on system functions.
  - e. Demonstrate system capabilities, operation and maintenance and educate Owner's representative on the foregoing.
3. At least three site visits to accomplish the following tasks:
  - a. Prior to wiring:
    - i. Review and provide installer with instructions to correct any errors in the following areas:
      1. Low voltage wiring requirements
      2. Separation of high and low voltage wiring runs
      3. Wire labeling
      4. Load schedule information
      5. Switching cabinet locations and installation
      6. Physical locations and network addresses of controls
      7. Ethernet connectivity
      8. Computer-to-network connections
      9. Load circuit wiring

10. Connections to other systems and equipment

11. Placement and adjustment of Occupancy Sensors

12. Placement and adjustment of Photocells

b. After system installation:

- i. Check and approve or provide correction instructions on the following:
  1. Connections of power feeds and load circuits
  2. Connections and locations of controls
  3. Connections of low voltage inputs
  4. Connections of the data network
- ii. Turn on system control processor and upload any pre-programmed system configuration
- iii. Verify cabinet address(es)
- iv. Upload pre-programmed system configuration and information to switching and/or dimming cabinets
- v. Check load currents and remove bypass jumpers
- vi. Verify that each system control is operating to specification
- vii. Verify that each system circuit is operational according to specification
- viii. Verify that manufacturers' interfacing equipment is operating to specification
- ix. Verify that any computers and software supplied by the manufacturer are performing to specifications
- x. Verify that any remote WAN (Wide Area Network) connections are operating properly
- xi. Have an owner's representative sign off on the above-listed system functions

c. Before project completion and hand-off:

- i. Demonstrate system capabilities and functions to owner's representative
  - ii. Train owner's representative on the proper operation, adjustment, and maintenance of the system.
- C. Notification: Upon completion of the installation, the contractor shall notify the manufacturer that the system is ready for formal checkout. Notification shall be given in writing a minimum of 21 days prior to the time factory-trained personnel are required on site. Each field installed RJ45 connection must be tested prior to system interconnection. A test report must be furnished to manufacturer prior to scheduling commissioning activity. Manufacturer shall have the option to waive formal turn-on.
- D. Turn-On: Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, Manufacturer's Certified Technician shall completely check the installation prior to energizing the system. Each installed relay system shall be tested for proper ON/OFF operations, and proper LED illumination. Each installed control cabinet shall be tested verifying that each controlled load adjusts to the selected setting and that all switch LED's illuminate properly.
- E. Provide written commissioning report including space/room names and numbers indicating list of all lighting equipment and devices tested and verifying proper operation of the system. Report shall include corrections, programming information/file, warranties, and owner's representative sign off on the above-listed system functions
- F. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

### 3.6 RETRO-COMMISSIONING:

- A. During the one year warranty period, provide retro-commissioning services at three month, six month, nine month, and one year marks. Provide at least 4 hours of commissioning service for each of the four retro-commissioning periods. This will include meeting with the Owner to receive feedback on the system and making changes to the system including programming, task tuning.

### 3.7 MAINTENANCE:

- A. Enable the end user to order new equipment for system expansion, replacements, and spare parts.
- B. Make new replacement parts available for a minimum of ten years from the date of manufacture.
- C. Manufacturing shall provide telephone technical support by factory personnel 24 hours a day, 7 days a week. Project cost overruns and delays can occur without this service. Answering services can add to frustration and delay the resolution of any problems or issues. Manufacturers who do not offer factory-direct technical support on a 24/7 basis should not be acceptable on this project.

- D. Provide factory-direct technical support hotline 24 hours per day, 7 days per week.
- E. Offer renewable annual service contracts, to include parts, factory labor, and annual training visits. Make service contracts available up to ten years after date of system commissioning.

3.8 WARRANTY:

- A. Manufacturer shall provide a one (1) year limited warranty on lighting control system. A ten (10) year limited warranty shall be provided on the lighting control relays.

3.9 AS-BUILT DRAWINGS:

- A. A complete set of 'as-builts' drawings showing installed wiring, specific interconnections between all equipment, and internal wiring of this equipment shall be included in the operating and maintenance manuals upon complete of the system.
- B. Provide a CD or USB storage (media) device to the owner containing the information specified below. The media shall include all information required to allow the Owner to change the schedules themselves. The media shall contain a minimum of following:
  - 1. CAD drawing files of 'as-built' lighting control components and point to point connections.
  - 2. General configuration programming.
  - 3. Job specific configuration programming to include schedule.
  - 4. Tutorial file on complete programming of lighting control system.

END OF SECTION 26 0943

## SECTION 26 2726 - WIRING DEVICES

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to wiring devices specified herein.

#### 1.2 DESCRIPTION OF WORK:

- A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems that are intended to carry but not utilize electric energy.
- B. Types of electrical wiring devices in this section include the following:
  - 1. Receptacles
  - 2. Switches
  - 3. Cord caps
  - 4. Cord connectors

#### 1.3 QUALITY ASSURANCE:

- A. Comply with NEC and NEMA standards as applicable to construction and installation of electrical wiring devices. Provide electrical wiring devices that have been UL listed and labeled.

#### 1.4 SUBMITTALS:

- A. Refer to Section 260502 for electrical submittal requirements.

### PART 2 - PRODUCTS

#### 2.1 FABRICATED WIRING DEVICES:

##### A. GENERAL:

- 1. Provide factory-fabricated wiring devices, in types, and electrical ratings for applications indicated and complying with NEMA Stds. Pub No. WD 1.
- B. Provide wiring devices (of proper voltage rating) as follows:

	<u>RECEPTACLE</u>	<u>SWITCHES</u>			
<u>MFGR</u>		<u>1-POLE</u>	<u>3-WAY</u>	<u>4-WAY</u>	<u>W-PILOT</u>

Hubbell	BR20XTR	HBL 1221	HBL 1223	HBL 1224	HBL 1221-PL
Bryant		1221	1223	1224	1221-PL
Pass Seymour	TR63X	20AC1	20AC3	20AC4	20AC1-RPL
Leviton	TWR20-X	1221	1223	1224	
Cooper	TR5362	1221	1273	1224	1221-PL

C. Provide devices in colors selected by Architect. Provide red devices on all emergency circuits.

D. SURGE PROTECTIVE (SPD) RECEPTACLES:

- Provide SPD receptacles having 4 series parallel 130V MOV's capable of a minimum of 140 joules suppression. Provide units with visual (and audible) surge status indicators to monitor condition of surge circuit; visual indicator to be "on" when power present and suppression circuit is fully functional. (Audible indicator shall sound a "beep" alarm approximately every 30 seconds if suppression circuit has been damaged.) Provide NEMA 5-20R, 20 amp, 125V receptacle of one of the following manufacturers:

	<u>MANUFACTURER</u>	
<u>SPECIFICATION GRADE</u>	<u>HUBBELL</u>	<u>PASS SEYMOUR</u>
Duplex Recept-Visual only	5350	5352 XXXSP
Duplex Recept-Visual/Audible	5352	5362 XXXSP
Single Recept-Visual only	5351	N/A
Duplex Recept-Isol Gnd, Visual/Audible	IG5352S	IG5362 XXXSP
Single Recept-Isol Gnd, Visual only	IG5351S	N/A
<u>HOSPITAL GRADE</u>	<u>HUBBELL</u>	<u>PASS SEYMOUR</u>
Duplex Recept-Visual/Audible	8300HS	8300 XXXSP
Single Recept-Visual only	8310HS	N/A
Duplex Recept-Isol Gnd, Visual/Audible	IG8300HS	IG8300 XXXSP
Single Recept-Isol Gnd, Visual only	IG8310HS	N/A

- Provide (1) SPD receptacle in all Flat Panel Display Wall Boxes ('DP' symbol)
- Color of devices selected by Architect. Provide red devices on all emergency circuits.

E. GROUND-FAULT INTERRUPTER:

- Provide general-duty, duplex receptacle, ground-fault circuit interrupters; feed-thru types, capable of protecting connected downstream receptacles on single circuit; grounding type UL-rated Class A, Group A, 20-amperes rating; 120-volts, 60 Hz; with solid-state ground-fault sensing and signaling; with 5



milliamperes ground-fault trip level; color as selected by Architect. Provide Hospital grade where required elsewhere by specification or drawings. Provide units of one of the following:

- a. P&S/Sierra
- b. Hubbell
- c. Leviton
- d. Square D

F. USB RECEPTACLE

- 1. Provide duplex receptacle with two (2) USB 3.0 amps, 5VDC, 2.0 Type A charging ports.
- 2. Provide products of one of the following:
  - a. Bryant – USB20-X
  - b. Cooper – TR7736-X
  - c. Hubbell – USB20X2-X
  - d. Legrand – TR5362USB-X
  - e. Leviton – T5832-X

G. TAMPER RESISTANT RECEPTACLES:

- 1. Provide tamper resistant receptacles throughout the entire project.
- 2. Provide products of one of the following:
  - a. Leviton-TWR20-X
  - b. Hubbell – BR20XTR
  - c. Pass Seymour – TR63X
  - d. Cooper – TR5362

H. WEATHER-RESISTANT RECEPTACLES

- 1. Provide weather-resistant receptacles in outdoor locations such as under roofed open porches, canopies, marquees, etc.
- 2. Provide products of one of the following:
  - a. Pass & Seymour 2095TRWRXXX.
  - b. Hubbell GFTR20XX

I. CORD CAPS AND CONNECTORS:

1. Provide 3, 4 and 5-wire grounding, cap plugs, and connectors of ampere and voltage rating required, for final equipment, and as indicated otherwise on drawings.
2. Provide products of one of the following:
  - a. Cooper
  - b. General Electric
  - c. Hubbell
  - d. Leviton
  - e. P&S

2.2 WIRING DEVICE ACCESSORIES:

A. WALL PLATES:

1. Provide stainless steel cover plates in all finished areas. Provide galvanized steel plates in unfinished areas. Provide blank coverplates for all empty outlet boxes.

B. WEATHER-PROTECTING DEVICE ENCLOSURES:

1. Where required for compliance with NEC 406-8 (receptacles installed outdoors for use other than with portable tools or equipment), provide weather-tight device covers that provide complete protection with the cord and cap inserted into the wiring device. Provide units that mount on either single or double gang devices.
2. Provide products of one of the following extra-duty low-profile expandable in-use weatherproof covers for exterior mounted installations:
  - a. Intermatic:

i.	WP7000W	Single-Gang/White Cover
ii.	WP7000G	Single-Gang/Gray Cover
iii.	WP7000BR	Single-Gang/Brown Cover
iv.	WP7200W	Double-Gang/White Cover
v.	WP7200G	Double-Gang/Gray Cover
vi.	WP7200BR	Double-Gang/Brown Cover
  - b. TayMac:

i.	ML500W	Single-Gang/White Cover
ii.	ML500G	Single-Gang/Gray Cover
iii.	ML500Z	Double-Gang/Brown Cover
iv.	ML2500G	Single-Gang/Gray Cover
  - c. Color chosen by architect.
3. Provide products of one of the following for roof mounted installations:

- a. Intermatic WP1020 or WP1030
- b. P&S WIUC10C or WIUC20c

### PART 3 – EXECUTION

#### 3.1 GENERAL

- A. Install wiring devices as indicated, in compliance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.
- B. Coordinate with other work, including painting, electrical box and wiring work, as necessary to interface installation of wiring devices with other work. Install devices in boxes such that front of device is flush and square with coverplate. Drawings are small scale and, unless dimensioned, indicate approximate locations only of outlets, devices, equipment, etc. Locate outlets and apparatus symmetrically on floors, walls and ceilings where not dimensioned and coordinate with other work. Verify all dimensioned items on job site. Consult architectural cabinet, millwork, and equipment shop drawings before beginning rough-in of electrical work. Adjust locations of all electrical outlets as required to accommodate work in area, and to avoid conflicts with wainscoat, back splash, tackboards, and other items.
- C. Where stranded conductors have been utilized, provide solid pigtails to terminate at device.
- D. Provide receptacles in surface raceway at 12" on center unless indicated otherwise.
- E. Install wiring devices only in electrical boxes that are clean; free from excess building materials, dirt, and debris.
- F. Install blank plates on all boxes without devices.
- G. Delay installation of wiring devices until wiring work and painting is completed. Provide separate neutral conductor from panel to each GFI receptacle.
- H. Install GFI receptacles for all receptacles installed in the following locations:
  - 1. Restrooms, locker rooms, kitchens, within 6 feet of any sink, or when serving vending machines and electric drinking fountains.
  - 2. Indoor wet locations, non-dwelling garages, elevator rooms and pits.
  - 3. Outdoors, and on rooftops.
  - 4. Dwelling unit garages, crawlspaces and unfinished basements, accessory buildings, boathouses, and receptacles for boat hoists.
  - 5. Label all receptacles (non-GFI), protected downstream of a GFI receptacle or protected by GFI circuit breaker, with an indication that it is protected.
- I. Where light switches or wall box dimmers are specified, provide a separate neutral for each phase of the branch circuits that switches or dimmers are connected.
- J. Electrical Identification: Refer to Section 260553 for requirements.

3.2 PROTECTION OF WALL PLATES AND RECEPTACLES:

- A. At time of substantial completion, replace those items, that have been damaged, including those stained, burned and scored.

3.3 GROUNDING:

- A. Provide electrically continuous, tight grounding connections for wiring devices, unless otherwise indicated.

3.4 TESTING:

- A. Prior to energizing circuitry, test wiring devices for electrical continuity and proper polarity connections. After energizing circuitry, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 26 2726

## SECTION 26 2815 - OVERCURRENT PROTECTIVE DEVICES

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to overcurrent protective devices specified herein.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of overcurrent protective device work is indicated by drawings and schedules and specified herein. Overcurrent protective devices specified herein are for installation as individual components in separate enclosures; and for installation as integral components of switchboard and panelboards. See Section 262413, Switchgear and Switchboards, and Section 262416, Panelboards.
- B. Contractor shall verify type and cost of all overcurrent protective devices required within existing gear and panelboards. Contractor shall include the necessary cost to provide devices within their bid.
- C. Types of overcurrent protective devices in this section include the following for operation at 600 Volts and below:
  - 1. Molded case thermal circuit breakers
- D. Refer to other Division-26 sections for cable/wire and connector work required in conjunction with overcurrent protective devices.

#### 1.3 QUALITY ASSURANCE

- A. Comply with NEC requirements and NEMA and ANSI standards as applicable to construction and installation of overcurrent devices.

#### 1.4 SUBMITTALS: Refer to Section 26 0503 for requirements.

### PART 2 – PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following (main and branch device manufacturer must be same as panelboard and/or switchboard manufacturer):
- B. PROVIDE CIRCUIT BREAKERS WITHIN NEW AND EXISTING GEAR:
  - 1. Siemens Energy & Automation, Inc. (Existing Brand/System On-site)
  - 2. Square D Company
  - 3. Cutler Hammer Products, Eaton Corp.

4. GE/ABB

C. MOLDED CASE THERMAL TRIP CIRCUIT BREAKERS:

1. Provide factory-assembled, molded case circuit breaker for power distribution panelboards and switchboards; and for individual mounting, as indicated. Provide breakers of amperage, voltage, and RMS interrupting rating shown, with permanent thermal trip and adjustable instantaneous magnetic trip in each pole. Series rated systems are not acceptable. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and in an ambient temperature of 40 degrees C. Provide with mechanical screw type removable connector lugs, AL/CU rated, of proper size to accommodate conductors specified.
2. Circuit breakers 15 amps through 599 amps shall be molded case thermal trip circuit breakers.

PART 3 – EXECUTION

3.1 INSTALLATION OF OVERCURRENT PROTECTIVE DEVICES:

- A. Install overcurrent protective devices as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.
- B. Coordinate with work as necessary to interface installations of overcurrent protective devices with other work.
- C. Install fuses in overcurrent protective devices. For motor circuits, fuse sizes shown on drawings are for general guidance only. Size fuses in accordance with fuse manufacturer's recommendation for given motor nameplate ampere rating. Test operation. If nuisance tripping occurs, increase fuse size and disconnect device (if necessary) as required to provide nuisance free tripping. Adjust fuse size properly for ambient temperature, frequent starting and stopping of motor loads, and for loads with long start times. Include all costs in bid.
- D. Electrical Identification: Refer to Section 260553 for requirements.

3.2 FIELD QUALITY CONTROL

- A. Prior to energization of overcurrent protective devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units, and then demonstrate compliance with requirements.

END OF SECTION 26 2815

## SECTION 26 4119 - DEMOLITION

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Special Provisions, Division 1 and Division-2 Specification sections, apply to work of this section.
- B. This section is a Division-26 Basic Materials and Methods section, and is part of each Division-26 section making reference to demolition.

#### 1.2 DESCRIPTION OF WORK:

- A. Extent of major items of demolition work is indicated by drawings. Other demolition work shall be performed as required to maintain system operation.
- B. The intent of the drawings is to indicate major items affected and not to show every device, outlet, fixture, etc. affected by demolition work.
- C. The drawings do not necessarily reflect as-built conditions. The contractor shall visit the jobsite prior to bidding to determine the overall scope of demolition work.
- D. Refer to sections of other Divisions for applicable requirements affecting demolition work.
- E. Refer to Section 260500 for requirements with regard to power outages affecting the operation of existing electrical systems.

#### 1.3 QUALITY ASSURANCE:

- A. NEC COMPLIANCE:
  - 1. Comply with applicable portions of NEC as to methods used for demolition work.

### PART 2 - PRODUCTS (NOT USED)

### PART 3 - EXECUTION

#### 3.1 GENERAL:

- A. Demolition work shall be laid out in advance to eliminate unnecessary cutting, drilling, channeling, etc. Where such cutting, drilling, or channeling becomes necessary, perform with care, use skilled mechanics of the trades involved. Repair damage to building and equipment. Cutting work of other Contractors shall be done only with the consent of that Contractor. Cutting of structural members shall not be permitted.

#### 3.2 PATCHING AND REPAIR

- A. The Contractor is responsible for all demolition, patching and repair of all finished interior surfaces pertaining to the installation of this particular phase of work. All surfaces shall be finished (painted, etc.) to match the adjacent materials, finishes and colors.
- B. Hard surfaces: Whenever demolition or excavation is required for the installation of the electrical system, it shall be the responsibility of this contractor to make repairs and/or replacements of hard finish surfaces such as concrete, asphalt, roofing, etc.

- C. The method of patching and repair shall follow good construction practices and all finished surfaces shall match materials and finish wherein the demolition occurred.

### 3.3 EXISTING EQUIPMENT

- A. The following is a part of this project and all costs pertaining thereto shall be included in the base bid.
- B. The new electrical equipment and apparatus shall be coordinated and connected into the existing system as required. Auxiliary systems shall comply, unless otherwise specified.
- C. The existing electrical devices, conduit and/or equipment that for any reason obstructs construction shall be relocated. Provide conduit, wiring, junction boxes, etc. as required to extend existing circuits and systems to relocated devices or equipment.
- D. The new fixtures indicated for existing outlets shall be installed in accordance with the fixture specifications.
- E. When installing equipment in the existing building, it shall be concealed.
- F. All existing electrical equipment and systems in portions of the building not being remodeled shall be kept operational, in service and in working condition throughout the entire construction period. Restore any circuits and systems interrupted. Provide temporary panels, temporary wiring and conduit, etc. as required.
- G. Maintain circuit integrity and continuity of all existing circuits and systems that interfere with or are interrupted by remodel work unless those circuits are to be abandoned completely. Maintain all circuits and systems in operation during construction. Provide temporary panels, temporary wiring and conduit, etc. as required.
- H. Existing raceways may be used where possible in place, except as noted. All circuits, conduit and wire that are not used in the remodeled area shall be removed back to the panelboard, where it shall be labeled a spare with circuit number indicated. Re-used raceway shall meet all requirements for new installations.
- I. The existing light fixtures that are not used in the remodeled area shall be carefully removed, and turned over to the owner or properly disposed of. Those fixtures indicated for re-use shall be thoroughly cleaned, repaired as required, re-lamped and installed as indicated.
- J. Move and adjust existing lighting as required for demolition and construction.
- K. Obtain permission from the Architect and Owner's representative before penetrating any ceiling, floor, and wall surfaces.
- L. Any and all equipment having electrical connections that require disconnecting and reconnection at the same or another location throughout the course of construction shall be included as part of this contract.

END OF SECTION 26 4119



## SECTION 26 5100 - INTERIOR AND EXTERIOR BUILDING LIGHTING

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

#### 1.2 DESCRIPTION OF WORK:

- A. Types of lighting fixtures in this section are indicated by schedule and include the following:
  - 1. LED (Light Emitting Diode)

#### 1.3 QUALITY ASSURANCE:

- A. Comply with NEC, NEMA and ANSI 132,1 as applicable to installation and construction of lighting fixtures. Provide lighting fixtures that have been UL-listed and labeled.
- B. Components and fixtures shall be listed and approved for the intended use by a National Recognized Testing Laboratory (NRTL) including: UL, ETL, and CSA or equivalent
- C. All led products shall comply with the latest version of Illuminating Engineer Society (IES) publications LM-79 and LM-80.

#### 1.4 SUBMITTALS:

- A. Refer to Section 260502 for electrical submittal requirements.

### PART 2 – PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS:

- A. Subject to compliance with requirements, provide products of one of the following (for each type of fixture):
  - 1. LED:
    - a. Cree
    - b. Nichia
    - c. Samsung
    - d. Philips Lumiled
    - e. Osram
    - f. Xicato

## 2.2 INTERIOR AND EXTERIOR LIGHTING FIXTURES:

### A. GENERAL:

1. Provide lighting fixtures, of sizes, types and ratings indicated complete with, but not necessarily limited to, housings, lamps, lamp holders, reflectors, ballasts, LED drivers, starters, and wiring. Label each fixture with manufacturer's name and catalog number. Provide all enclosed fixtures with positive latch mechanisms; spring tension clips not acceptable. Provide all exterior fixtures with damp or wet location label as required by application.

### B. SUPPORT REQUIREMENTS:

1. Provide all pendant and stem hung fixtures with flexible ball joint hangers at all points of support. Equip hooks used to hang fixtures with safety latches. Provide all detachable fixture parts, luminous ceiling accessories, louvers, diffusers, lenses, and reflectors with locking catches, screws, safety chain, or safety cable.

### C. LIGHT EMITTING DIODE (LED) LUMINAIRES:

1. LED luminaires that can be serviced in place shall have a disconnecting means internal to the luminaires to disconnect simultaneously from the source of supply all conductors of the driver, including the grounded conductor. Disconnects shall not be required under the following exceptions:
  - a. Luminaires located in hazardous locations.
  - b. Luminaires used for egress lighting.
  - c. Cord-and-plug luminaires.
  - d. In industrial establishments with restricted public access where conditions of maintenance and supervision ensure that only qualified persons service the installation.
  - e. Where more than one luminaire is installed in a space and where disconnecting the supply conductors to the luminaire will not leave the space in total darkness.
  - f. Provide LED luminaires which are tested in accordance with IES LM-79, diodes tested in accordance with IES LM-80, and provide a minimum R9 rating of  $\geq 50$  (unless specified differently), a CRI rating of  $\geq 80$  and L70 (6K) = 50,000 hours (IES TM-21). Provide with 0-10V dimming drivers as standard.
  - g. The fixture manufacturer(s) shall warrant the luminaires, in their entirety, to be free from defects in material or workmanship for at least 5 years from date of manufacture. Provide warranty in accordance with other sections of this specification and include a certificate of warranty from the fixture manufacturer with extended warranty information and proper forms and procedure description.

### D. DIFFUSERS:

1. Where plastic diffusers are specified, provide 100 percent virgin acrylic compound; minimum thickness, .125 inches.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION OF LIGHTING FIXTURES

- A. Install lighting fixtures at locations and heights as indicated, in accordance with fixture manufacturer's written instructions, applicable requirements of NEC, NECA's "Standards of Installation", NEMA standards, and with recognized industry practices to ensure that lighting fixtures fulfill requirements.
- B. Coordinate with other work as appropriate to properly interface installation of lighting fixtures with other work. Consult architectural reflected ceiling plan for exact location of all lighting fixtures.
- C. Provide all necessary supports, brackets, and miscellaneous equipment for mounting of fixtures. Support all ceiling mounted fixtures from the building structure; independent of the ceiling system, unless noted. Support each recessed fixture (fluorescent incandescent, and/or HID) from the building structure with #12 ga. steel wire attached to each corner (in addition to supports normally provided for attachment to the ceiling system). Provide backing supports above (or behind) sheetrock, plaster and similar ceiling and wall materials. Support surface mounted ceiling fixtures from channel. Support ceiling mounted outlet boxes independent of the raceway system, and capable of supporting 200 pounds. Feed each recessed fixture directly from an outlet box with flex conduit as required; do not loop from fixture to fixture. See plans for additional details.
- D. FIXTURE WHIPS:
  - 1. Provide each lay-in light fixture with at least 36" (Not to exceed 72") of 3/8" steel flexible conduit.
  - 2. With-in spaces utilizing 0-10v control schemes ie: Room Controllers, the fixture whip shall be comprised of a MC-PCS Cable (see Section 26 0532 Conduit raceways) with at least 36" and not to exceed 72" in length located above removable grid ceilings.
- E. Coordinate lighting in mechanical room with duct and equipment locations to avoid obstruction of illumination.
- F. Provide gypsum board protection as required, (acceptable to fire official having jurisdiction) to ensure fire rating of each ceiling that the fixtures are installed in.
- G. COORDINATION MEETINGS:
  - 1. Meet at least twice with the architect and ceiling installer. Hold first meeting before submittal of shop drawings to coordinate each light fixture mounting condition with ceiling type. During second meeting, coordinate fixture layout in each area.
    - a. Coordinate mounting height of pendant and wall mounted fixtures.
    - b. Coordinate conduit layout in all open ceiling spaces e.g. Gym, Commons, Auditorium, etc. with architect prior to rough-in.
  - 2. Meet at least twice with the AV/Intercom systems Installer. Hold first meeting before submittal of shop drawings to coordinate each AV equipment, speaker mounting condition with ceiling type. During second meeting, coordinate AV equipment, speaker layout in each area.

3. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all fixtures and duct work in all areas.

H. ADJUST AND CLEAN:

1. Clean lighting fixtures of dirt and debris upon completion of installation.
2. Protect installed fixtures from damage during remainder of construction period. Repair all nicks and scratches to appearance of original finish.

3.2 FIELD QUALITY CONTROL:

- A. Upon completion of installation of lighting fixtures, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements.
- B. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise remove and replace with new units, and proceed with retesting.
- C. At the time of Substantial Completion, replace lamps in interior lighting fixtures that are observed to be noticeably dimmed after the Contractor's use and testing, as judged by Architect/Engineer.
- D. GROUNDING:
  1. Provide equipment grounding connections for each lighting fixture.

END OF SECTION 26 5100



INFORMATION TECHNOLOGIES  
8/31/2018



# *Canyons School District*

## Network Cabling Global Specification

### Information Technologies

**Final Draft**  
**Wednesday August 31, 2018**



**Scot McCombs**  
**Director of IT**

## **Table of Contents**



	<b>1</b>
<b>I. GENERAL</b>	<b><u>44</u></b>
A. Purpose	<u>44</u>
B. Scope of Work - Typical	<u>44</u>
C. Applicable Regulatory References	<u>55</u>
D. Substitution Policy	<u>99</u>
E. Contractor Qualifications	<u>99</u>
F. Warranty	<u>1111</u>
<b>II. Installation and Maintenance Guidelines</b>	<b><u>1414</u></b>
A. Maintenance of Patch Fields	<u>1414</u>
B. Cable Pulling and Termination	<u>1414</u>
<b>III. Cabling Systems and Associated Infrastructure</b>	<b><u>1717</u></b>
A. Cabling Subsystem I – Horizontal Cabling System	<u>1717</u>
C. Cabling Subsystems II - Intrabuilding Backbone Fiber	<u>2424</u>
D. Cable Pathways	<u>2828</u>
E. 19" Racks and Rack-mount Cable Managers	<u>2929</u>
F. Cable Accessories	<u>3333</u>
G. Communications Grounding Network	<u>3333</u>
H. Communications Entrance Facilities	<u>3636</u>
<b>IV. Network Labeling</b>	<b><u>3636</u></b>
A. General Requirements	<u>3636</u>
<b>V. Testing and Acceptance</b>	<b><u>3737</u></b>
A. General	<u>3737</u>
a. Copper Link Testing	<u>3737</u>
b. Fiber Testing	<u>3838</u>
c. System Documentation	<u>3838</u>
d. Test Results	<u>3939</u>
<b>Appendix A – Materials List</b>	<b><u>4141</u></b>



INFORMATION TECHNOLOGIES  
8/31/2018

---



## I. GENERAL

### A. Purpose

1. The purpose of this document is to provide a standard defining the structured communications cabling systems to be installed within Canyons School District facilities. It is geared toward leveraging our legacy cabling infrastructure while upgrading to more recent technologies in new installations. The goal is to accomplish this in the most economic and systematic fashion possible, and in a manner compliant with the latest codes, cabling standards and industry best practices.
2. Within this document, the facilities owner is Canyons School District, and shall be referred to as such, or as "Canyons School District" or simply as "Information Technologies". Bidding low-voltage installers shall be referred to as "Contractor".
3. This specification defines quality standards and practices common to all Canyons School District Information Technologies enterprise network cabling upgrades and greenfield (new) projects.
4. In addition to this global cabling standard, individual projects will also have associated documentation such as Requests for Proposals (RFP), facility drawings, project schedules and requirements pertaining to that particular job. Such collateral will be referred to in this document as "Project Specific Documentation" or simply "Construction Documents". Any conflict between this general specification and any project specific documentation shall be brought to the attention of Canyons School District Information Technologies and must be resolved in writing by Canyons Schools.
5. It is the responsibility of the installing contractor to evaluate these general recommendations and adapt them effectively to actual projects. Contractor is responsible for identifying and bringing to the attention of Canyons School District Information Technologies any design directions that may be improved. All such changes shall be approved in writing from Information Technologies.
6. Note that while many portions of this global specification are addressed to "The Contractor", these requirements apply equally to anyone doing the network cabling and infrastructure work within Canyons School District, whether those persons are outside contractors or persons directly employed by Information Technologies.

### B. Scope of Work - Typical

1. Contractor shall be solely responsible for all parts, labor, testing, documentation and all other associated processes and physical apparatus necessary to turn over the completed system fully warranted and operational for acceptance by Canyons School District Information Technologies
2. This specification includes structured cabling design considerations, product specifications and installation guidelines for low-voltage network systems and associated infrastructure including, but not limited to:





- a. Cabling Sub-system 1 – Horizontal Copper
  - b. Cabling Sub-system 2 - Intra-building Fiber Backbone Cabling
  - c. Telecommunications Pathways
  - d. Communications Racks
  - e. Communications Grounding Systems
  - f. Cabling Labeling and Administration
3. In addition to systems specifications, this document also addresses applicable codes and standards, contractor qualifications and requirements, system warranties and system testing and acceptance.
  4. Products to be used in Canyons School District Information Technologies telecommunications infrastructure are listed in "Appendix A" at the end of this document. All approved 'equivalents' must match performance specifications.

### **C. Applicable Regulatory References**

---

1. Contractor is responsible for knowledge and application of current versions of all applicable standards and codes. In cases where listed standards and codes have been updated, Contractor shall adhere to the most recent revisions, including all relevant changes or addenda at the time of installation.
2. ANSI/TIA:
  - a. ANSI/TIA-526-7-A (July 2015) Measurement of Optical Power Loss of Installed Single-Mode Fiber Cable Plant
  - b. TIA-526.2-A (July 2015) Effective Transmitter Output Power Coupled into Single-Mode Fiber Optic Cable - Adoption of IEC 61280-1-1 ed. 2 Part 1-1: Test Procedures for General Communication Subsystems – Transmitter Output Optical Power Measurement for Single-Mode Optical Fibre Cable
  - c. ANSI/TIA-4994 (March 2015) Standard for Sustainable Information Communications Technology
  - d. ANSI/TIA-526-14-C (April 2015) Optical Power Loss Measurements of Installed Multimode Fiber Cable Plant
  - e. ANSI/TIA-568.0-D (September 2015) Generic Telecommunications Cabling for Customer Premises (supersedes TIA-568-C.0 and TIA-568-C-1)
  - f. ANSI/TIA-568-C.2 (August 2009) Balance Twisted Pair Communications and Components Standards
  - g. TIA-568-C.2-1 (July 2016) Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 1: Specifications for 100 Next Generation Cabling
  - h. TIA-568-C.2-2 (November 2014) Balanced Twisted-Pair Telecommunications Cabling and Components Standard, Addendum 2: Additional Considerations for Category 6A Patch Cord Testing



- i. TIA-568-C.3 (June 2008) Optical Fiber Cabling Components Standard (will be superseded by ANSI/TIA-568.3-D after default ballot)
- j. TIA-568-C.3-1 (October 2011) Optical Fiber Cabling Component Standard- Addendum 1, Addition of OM4 Cabled Optical Fiber and array connectors (will be superseded by ANSI/TIA-568.3-D after default ballot)
- k. ANSI/TIA-568-C.4 (July 2011) Broadband Coaxial Cabling Components Standard
- l. ANSI/TIA-568.1-D (September 2015) Commercial Building Telecommunications Infrastructure Standard (supersedes ANSI/TIA-C.1)
- m. ANSI/TIA-569-D (April 2015) Telecommunications Pathways and Spaces
- n. ANSI/TIA-598-D (July 2014) Optical Fiber Cable Color Coding
- o. ANSI/TIA-570-C (August 2012) Residential Telecommunications Infrastructure Standard
- p. ANSI/TIA-606-C (June 2017) Administration Standard for Telecommunications Infrastructure
- q. ANSI/TIA-607-C (November 2015) Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
- r. ANSI/TIA-758-B (March 2012) Customer-Owned Outside Plant Telecommunication Infrastructure Standard
- s. ANSI/TIA-862-B (February 2016) Structured Cabling Infrastructure Standard for Intelligent Building Systems
- t. ANSI/TIA-942-B (July 2017) Telecommunications Infrastructure Standard for Data Centers (will be superseded by ANSI/TIA-942-B after balloting)
- u. ANSI/TIA-1005-A (May 2012) Telecommunications Infrastructure Standard For Industrial Premises
- v. ANSI/TIA-1005-A-1 (January 2015) Telecommunications Infrastructure Standard For Industrial Premises, Addendum 1- M12-8 X-Coding Connector - Addendum to TIA-1005-A
- w. ANSI/TIA-1183 (August 2012) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems
- x. ANSI/TIA-1183-1 (January 2016) Measurement Methods and Test Fixtures for Balun-Less Measurements of Balanced Components and Systems, Extending Frequency Capabilities to 2 GHz - Addendum to TIA-1183
- y. ANSI/TIA-1152 (September 2009) Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
- z. ANSI/TIA-1179 (July 2010) Healthcare Facility Telecommunications Infrastructure Standard
- aa. ANSI/TIA-4966 (May 2014) Telecommunications Infrastructure Standard for Educational Facilities
- bb. TIA-455-104-B (February 2016) FOTP 104- Fiber Optic Cable Cyclic Flexing Test (supersedes TIA-455-104-A)
- cc. TIA/EIA-455-25-D (February 2016) FOTP-25 Impact Testing of Optical Fiber Cables



- dd. TIA-604-18 (November 2015) FOCIS 18 Fiber Optic Connector Intermateability Standard – Type MPO-16
- ee. TIA-604-5-E (November 2015) FOCIS 5 Fiber Optic Connector Intermateability Standard- Type MPO
- ff. TIA-5017 (March 2016) Telecommunications Physical Network Security Standard
- gg. TIA-TSB-155-A (Reaffirmed 10-6-2014) Guidelines for the Assessment and Mitigation of Installed Category 6 Cabling to Support 10GBASE-T
- hh. TSB-184-A (March 2017) Guidelines for Supporting Power Delivery Over Balanced Twisted-Pair Cabling
- ii. TSB-4979 (August 2013) Practical Considerations for Implementation of Multimode Launch Conditions in the Field
- jj. TSB-190 (June 2011) Guidelines on Shared Pathways and Shared Sheaths
- kk. TIA-TSB-162-A (November 2013) Telecommunications Cabling Guidelines for Wireless Access Points
- ll. TSB-5018 (July 2016) Structured Cabling Infrastructure Guidelines to support Distributed Antenna Systems
- mm. TIA-492AAAD (October 2009) Detail specification for 850-nm laser-optimized, 50-um core diameter/125-um cladding diameter class la graded-index multimode optical fibers
- nn. TIA-455-243 (March 2010) FOTP-243 Polarization-mode Dispersion Measurement for Installed Single-mode Optical Fibers by Wavelength-scanning OTDR and States-of-Polarization Analysis
- oo. TSB-172-A (February 2013) Higher Data Rate Multimode Fiber Transmission Techniques

### 3. ISO/IEC

- a. ISO/IEC 11801 Edition 2.2: Information Technology – Generic Cabling For Customer Premises
- b. ISO/IEC 24702 Edition 1.0: Information Technology – Generic Cabling – Industrial Premises
- c. ISO/IEC 24764 Edition 1.0: Information Technology – Generic Cabling Systems For Data Centres
- d. ISO/IEC 14763-2 Edition 1.0: Implementation and Operation of Customer Premises Cabling – Part 2: Planning and Installation
- e. ISO/IEC 14763-3 Edition 1.1: Implementation and Operation of Customer Premises Cabling – Part 3: Testing of Optical Fiber Cabling

### 4. National Electric Codes

- a. National Electrical Safety Code (NESC) (IEEE C2-2012)
- b. ANSI/NFPA 70-2011, National Electrical Code® (NEC®)
- c. ANSI/IEEE C2-207, National Electrical Safety Code®
- d. National Electrical Code (NEC) (NFPA 70)

### 5. OSHA Standards and Regulations – all applicable



6. Local Codes and Standards – all applicable
7. BICSI – Building Industry Consultative Services International
  - a. Telecommunications Distribution Methods Manual, 13th Edition
  - b. ANSI/BICSI 005-2013, Electronic Safety and Security (ESS) System Design and Implementation Best Practices
  - c. Information Transport Systems Installation Methods Manual (ITSIMM), 6th Edition
  - d. ANSI/BICSI 002-2011, Data Center Design and Implementation Best Practices
  - e. Network Systems and Commissioning (NSC) reference, 1st Edition
  - f. ANSI/NECA/BICSI 568-2006, Standard for Installing Commercial Building Telecommunications Cabling
  - g. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
  - h. AV Design Reference Manual, 1st Edition
  - i. Network Design Reference Manual, 7th Edition
  - j. Outside Plant Design Reference Manual, 5th Edition
  - k. Wireless Design Reference Manual, 3rd Edition
  - l. Electronic Safety and Security Design Reference Manual, 3rd Edition
  - m. Commercial Installation On-the-Job Training Booklet
  - n. Telecommunications Project Management (TPM) reference, 1st Edition
8. Anywhere cabling standards conflict with electrical or safety codes, Contractor shall defer to the NEC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.
9. Anywhere standards, codes, specifications or project documents conflict, Contractor shall default to the standards of the country where the installation is taking place, or default to the more stringent of either. Where such resolutions are not clear, it is the responsibility of the Contractor to bring this to the attention of the local Canyons School District project manager to receive clarification in writing.
10. Knowledge and execution of applicable standards and codes is the sole responsibility of the Contractor.
11. Any violations of applicable standards or codes committed by the Contractor shall be remedied at the Contractor's expense.



---

#### **D. Substitution Policy**

---

1. This is a performance-based specification based on the experience of Canyons School District Information Technologies in providing exceptional solutions for all of our facilities and departments. As such, substitution of specified systems is discouraged, but allowed if Contractor strictly follows the Canyons Substitution Policy outlined below. The right to determine suitability, compatibility, or acceptability of product/service offerings belongs exclusively to Canyons School District.
2. Contractors offering product substitutions or equivalents are responsible for showing equal or superior mechanical and transmission performance specifications to those products listed herein.
3. The process for substituting products other than those specified is as follows:
  - a. Any Contractor wishing to offer structured cabling or associated infrastructure products other than those specified should submit a request for product substitution in writing at least ten (10) business days prior to the closing of the bid for which the substitution is requested.
  - b. Written requests for substitution should be accompanied by three samples of the substitution product along with associated drawings, specification sheets and engineering documents for evaluation by Canyons School District.
  - c. Any copper or fiber cabling products that carry signal shall be accompanied by third party laboratory performance test reports from an NRTL (Nationally Recognized Testing Laboratory) proving equivalency in transmission performance.
4. Equal product acceptance is exclusively at Canyons School District discretion.
5. Contractor shall assume all costs for removal and replacement of any substituted product installed without prior written approval. Such costs shall include but not be limited to labor, materials as well as any penalties, fees or costs incurred for late completion.

---

#### **E. Contractor Qualifications**

---

1. General
  - a. Contractor must have at least 5 years documented experience installing and testing structured cabling systems of similar type and size.
  - b. Contractor shall have offices and service personnel based with a fifty-mile radius of Canyons School District and be capable of same-day response to service calls.
  - c. Contractor shall employ at least one BICSI Registered Communication Distribution Designer (RCDD) to sign-off on all designs offered, including stamping the design with their current BICSI/RCDD stamp.
  - d. Contractor shall have the responsibility to obtain any of the necessary permits, licenses, and inspections required for the performance of data, voice, and fiber optic cable installations.
  - e. Contractor shall be a current Panduit ONE<sup>SM</sup> Partner, Silver or above, Leviton/Berk-Tek Certified Installer, Siemon/Mohawk Certified Installer, or accepted substitute manufacturer (See Substitution Policy). A copy of the corporate manufacturer certification must be included with quote.



- f. At least 30 percent of the technicians on the job must have a current Panduit Certified Copper Technicians certificate, Leviton/Berk-Tek Certified Copper Technicians certificate, Siemon/Mohawk Certified Installer certificate, or accepted substitute manufacturer, to install copper distribution systems.
- g. At least 30 percent of the technicians installing any Fiber Distribution Systems must have a current Panduit Certified Fiber Technicians certificate, Leviton/Berk-Tek Certified Fiber Technicians certificate or accepted substitute manufacturer certificate, to install fiber distribution systems
- h. The Telecommunications contractor must provide a project manager to serve as the single point of contact to manage the installation, speak for the contractor and provide the following functions:
  - Initiate and coordinate tasks with the Canyons School District Information Technologies Project Manager and others as specified by the project schedule.
  - Provide day to day direction and-site supervision of Contractor personnel.
  - Ensure conformance with all contract and warranty provisions.
  - Participate in weekly site project meetings.
  - This individual will remain project manager for the duration of the project. The contractor may change Project Manager only with the written approval of Canyons School District Information Technologies.
- i. Contractor Project Manager must be manufacturer certified in the copper and fiber information distribution systems to be installed.

## 2. References

- a. Communications Contractor shall provide with bid, a list of three reference accounts where similar Data, Voice, Fiber Optic Cable, and related equipment installation work was performed within the last year (twelve month period).

## 3. Termination of Services

- a. Canyons School District Information Technologies reserves the right to terminate the Communication Contractor's services if at any time the Information Technologies Engineer determines the Communication Contractor is not fulfilling their responsibilities as defined within this document.
- b. Contractor's appearance and work ethics shall be of a professional manner, dress shall be commensurate with work being performed.
- c. Dress displaying lewd or controversial innuendos will strictly be prohibited.
- d. Conduct on Canyons School District Information Technologies property will be professional in nature.
- e. Any person in the Contractor's employ working on a Canyons School District Information Technologies project considered by Canyons School District Information Technologies to be incompetent or disorderly, or for any other reason unsatisfactory or undesirable to the Information Technologies, such person shall be removed from work on the Canyons School District Information Technologies project.
- f. Upon termination, the Communications Contractor shall be restricted from the premises and compensated for the percentage of work completed satisfactorily.





#### 4. Other Contractor Responsibilities

- a. Confirmation of Pathway and Cable Manager Sizing:
  - Wherever cabling pathways or managers are installed, it is the Contractor's responsibility to confirm pathway or manager sizing to represent no more than 30% fill according to manufacturer's fill charts based on projected cable densities when racking systems and cabling pathways are fully populated.
  - Pathways overfilled upon installation will not be accepted and shall be remedied at Contractor expense.
- b. Contractor is responsible for the removal and disposal of all installation and construction debris created in the process of the job. All work areas will be cleaned at the conclusion of the workday and no tools or materials shall be left in a manner as to pose a safety hazard.
- c. Contractor must remove all abandoned cable per Article 800 of the National Electrical Code and per TIA and BICSI standards, recycling these materials where possible. Removal of orphaned cable is mandatory. Contractors must consider this when placing bids.
- d. Contractor shall abide by the regulations set by local Canyons School District's Security Policy pertaining to access and conduct while on Canyons School District property.
- e. Contractor shall all obey all posted speed limits and parking regulations at the Canyons School District facilities where the work is being performed.

#### **F. Warranty**

---

##### 1. General

- a. Contractor shall provide a minimum 3 year warranty on all copper and fiber permanent cabling links. A 25-year extended warranty is desired and will be considered as preferred. Costs to increase the warranty beyond 3 years should be included with ineligible costs, if part of an e-rate project.
- b. Upon acceptance of Warranty the contractor will mail a notification letter to the installer and a notification letter and warranty certificate to Canyons School District Information Technologies.

##### 2. Contractor Warranty Obligations

- a. Installation firm (Contractor) must be a current Panduit ONE<sup>SM</sup> Partner, Silver or above, Leviton/Berk-Tek Certified Installer, Siemon/Mohawk Certified Installer, or Canyons School approved equal manufacturer in good standing and shall include a copy of the company installation certification with the bid.
- b. Contractor shall name a supervisor to serve on site as a liaison responsible to inspect and assure all terminations are compliant to factory methods taught in Panduit Technician Certification Training, Leviton/Berk-Tek Technician Certification Training, Siemon/Mohawk MAC or Canyons School approved equal, and according to all Standards cited in the Regulatory References section of this document.
- c. Contractor liaison (project supervisor) shall have a current, up-to-date Panduit Certified Technician (PCT) certificate, Leviton/Berk-Tek Certified Technician certificate, Siemon/Mohawk, or Canyons School approved equal in both copper and fiber. Copies of the copper and fiber certificates of the Panduit,



- Leviton/Berk-Tek, or Canyons School approved equal liaison shall be submitted with the bid. These requirements are the same for accepted equivalent manufacturers. See "Substitution Policy" for mandatory procedure when offering substitutions.
- d. Fiber optic cabling system additions and upgrade to existing facilities (Brownfield) shall match the fiber type (OM/OS designation) of the system to which it is being installed. Contractor shall under no circumstances mix different OM/OS classes of cable or termination devices (connectors) within the same system.
  - e. All intra-building new fiber optic installations shall utilize an appropriate construction of OM3 or OM4 multi-mode fiber as specified herein.
  - f. All UTP cable pulled and terminated shall be Category 6a cable and connectivity whether new or legacy systems. The exception to this is the 25 pair Category 5E cable installed for building controls as specified in this document.
  - g. All UTP terminations within the Canyons School District Information Technologies greenfield (new) projects shall be terminated using the T568B pin-out (wire map). Legacy additions shall match the copper pin-out of the facility to which cabling is being added-to or upgraded.
  - h. Contractor shall install all racking and support structures according to cited Standards in such fashion as to maintain both cited industry standards as well as manufacturer recommendations for uniform support, protection, and segregation of different cable types,
  - i. Contractor is responsible for maintenance of maximum pulling tensions, minimum bend radius, and approved termination methods as well as adhering to industry accepted practices of good workmanship.
  - j. Contractor is responsible for understanding and submitting to Panduit or Leviton/Berk-Tek all documents required prior to project start to apply for the Panduit Certification PLUS or Pan/Gen system warranty, Leviton/Berk-Tek Limited Lifetime Warranty, or Siemon Premium Warranty. These include but are not limited to the project information form and SCS warranty agreement. These requirements are the same for accepted equivalent manufacturers. See "Substitution Policy" for mandatory procedure when offering substitutions.
  - k. Contractor is responsible for understanding and submitting to Panduit, Leviton/Berk-Tek, Siemon/Belden, or other, all documents required at project end. These include, but are not limited to: completed warranty forms, passing test reports and drawings of floor plans showing locations of links tested. These requirements are the same for accepted equivalent manufacturers. See "Substitution Policy" for mandatory procedure when offering substitutions.
  - l. Test results shall be delivered in the tester native format (not Excel) and represent the full test report, summaries shall not be accepted. Contact your Panduit, Leviton/Berk-Tek, Siemon/Belden, or Canyons School approved equal's representative for a current list of approved testers, test leads and latest operating systems.
  - m. The Communications Contractor will correct any problems and malfunctions that are warranty-related issues without additional charge to Canyons School District Information Technologies for the entire warranty period.
  - n. The warranty period shall commence following the final acceptance of the project by Canyons School District Information Technologies and written confirmation of Warranty from Panduit, Leviton/Berk-Tek, or Siemon/Belden. These requirements are the same for accepted equivalent manufacturers. See





---

"Substitution Policy" for mandatory procedure when offering substitutions.

END OF SUB-SECTION SECTION I



## II. Installation and Maintenance Guidelines

### A. Maintenance of Patch Fields

---

1. Any persons, whether with a Contractor or Canyons School District, adding or moving copper or fiber optic patch (equipment) cords shall do so in a neat, workmanlike fashion in keeping with the original system cable management design concept and according to all industry best practices as outlined in cabling standards and applicable BICSI publications referenced in this document.
2. Persons performing such moves, adds or changes (MACs) shall further adhere to the following:
  - a. Use existing cabling management pathways and take care to place cable like with like, maintaining original segregation strategies for separating fiber and copper cables as well as any separation necessary between different types of copper cables.
  - b. Cables shall be dressed neatly within patch management pathways with care taken to maintain minimum bend radius of not less than 1 times the cord outer diameter for copper and not less than a 1" bend radius for fiber jumpers as per ANSI/TIA 568-C.0.
  - c. All patch cords used shall be of same copper Category or fiber OM/OS designation as the media used in the permanent cabling links.
  - d. Patching in all cases shall be done using factory terminated cords manufactured for that purpose. Hand terminated patch cords will not be accepted.
  - e. All patch cords or jumpers must be completely contained within supplied cable management paths. Cables draped across the front of cabinets or racks will not be accepted and shall be remedied at Contractor's expense.
  - f. Any persons installing or moving fiber optic patch cords for any reason will clean the connector with lint-free wipes and 99% or higher isopropyl alcohol before replacing the connector in a patch or equipment port.
  - g. Any technicians, whether with Canyons School District or Contractors performing moves, adds or changes within patch field will label additions to the system according to the labeling conventions in place at that facility.
  - h. Any persons with Canyons School District or installing Contractor performing moves, adds or changes within patch field will record the move according to record system in place at that facility.

### B. Cable Pulling and Termination

---

1. General
  - a. Contractor is responsible for installing systems according to all applicable codes and the standards cited in this document.
  - b. Contractor shall use grommets to protect the cable when passing through metal studs or any openings that can possibly cause damage to the cable.



- c. Do not deform the jacket of the cable. The jacket shall be continuous, free from pinholes, splits, blisters, burn holes or other imperfections.
  - d. Install proper cable supports, spaced less than 5 feet apart, and within manufacturer's requirements for fill ratio and load ratings.
  - e. Leave a pull string to the end of each conduit run. Replace pull string if it was used for a cable pull.
  - f. Note service loops may not touch the ceiling assembly and if so must be remedied at the Contractor expense.
  - g. Label every cable within 12 in. of the ends with self-laminating wire wrap cable appropriate to that cable size. Use a unique number for each cable segment as required by the project documentation and the labeling section of this document.
  - h. Dress the cables neatly with hook and loop cable ties in telecommunications rooms. Plastic ties are approved in pathways where cable bundles will not be reentered.
  - i. Contractor is responsible for using plenum-rated cable ties in plenum spaces.
  - j. Contractors installing cabling systems in Canyons School District facilities shall install plenum rated cable in all instances. Non-plenum cable is not allowed and shall be removed at Contractor's expense.
- a. Copper
- a. When making additions to legacy systems, Contractor shall match the cabling configuration (pinout) of the existing systems. Legacy systems at Canyons School District Information Technologies are in most cases T568B.
  - b. Within all new (greenfield) installations within Canyons School District facilities, contractor shall use copper pinout T568B.
  - c. All four pair Category 6a cable runs shall be kept to a maximum permanent link length of 83 meters when using a total 10 meters of 28 awg/small diameter patch cords.
  - d. Copper links that are 90 meters in permanent link, shall not exceed 6 meters (total) of patch cords when using 28 awg/small diameter patch cords.
  - e. Use low to moderate force when pulling cable. Maximum tensile load may not exceed 25' lbs. maximum pulling force per 4 pair cable.
  - f. No pathway, including conduits shall have greater than a 30% fill per manufacturer fill charts. Contractor is responsible for bringing to the attention of Canyons School District Information Technologies project manager any insufficiently sized conduit or cable pathways in project documentation.
  - g. Keep Category 6a cables as far away from potential sources of EMI (electrical cables, transformers, light fixtures, etc.) as required in cited TIA Standards.
  - h. All copper horizontal cabling shall have slack service loops no less than 12" at the work area (equipment outlet) and not less than 3 feet in the telecommunications room. Provide a 25' service loop for all cables for cameras.
  - i. Slack at the work area may be stored in the ceiling and in the telecommunications room may be wall



- mounted or contained in pathways or racking systems if done in a neat, workmanlike fashion.
- j. Service loops shall be stored in such fashion as to not violate bend radius, slack touching the drop ceiling is not allowed and must be remedied at Contractor expense.
  - k. Maintain the twists of the pairs all the way to the point of termination, or no more than 0.5" (one half inch) untwisted.
  - l. All UTP patching shall be accomplished using Category 6a rated modular patch panels as indicated elsewhere in this document.
  - m. All removed copper cable is to be disposed of in a Canyons School District Information Technologies recycling bin designated for "copper", or removed from the property to be disposed of by Contractor if this is the instructions in the project documentation.
- b. Fiber
- a. When making additions to legacy systems, Contractor shall match the fiber type and fiber connectors used within that system.
  - b. Within all new (greenfield) fiber installations within Canyons School District Information Technologies, contractor shall use Panduit OptiCam, Leviton FastCam, Siemon/Belden or Canyons School approved equal LC connectors as specified in the fiber section of this document.
  - c. When installing fiber cable, Contractor shall maintain a minimum bend radius, both under pulling load and installed, per requirements outlined within TIA standards, or manufacturer's recommendations, whichever is the most stringent.
  - d. Fiber terminations shall be done according to recommendations of TIA, manufacturer's requirements and accepted industry best practices.
  - e. All unjacketed fiber shall be contained within appropriate fiber enclosures. Exposed tight-buffered or loose-tube strands will not be tolerated and shall be remedied at Contractor's expense.
  - f. Contractor shall use fusion splices when terminating loose-tube fiber.
  - g. Contractor shall perform test setup and testing according to guidelines in the "Testing and Acceptance" section of this document.
  - h. All fiber backbone links will extend from each IDF directly to the MDF (Home Run) except where agreed to by exception with Canyons School District Director of IT.

END OF SUB-SECTION SECTION II



### III. Cabling Systems and Associated Infrastructure

#### A. Cabling Subsystem I – Horizontal Cabling System

---

##### 1. Slack (Service Loops) in Horizontal UTP Cable

- a. Contractor shall provide a minimum 12" slack or service loop at the equipment outlet (work area) on each terminated copper horizontal permanent link. Work area slack shall be contained within boxes behind the faceplate only if this may be done easily without violating cable bend radius.
- b. Where there is not sufficient space in the work area box, Contractor may pull work area slack into the ceiling space and properly store service loop with appropriately rated hook and loop cable ties. Cable slack shall in no instances touch the ceiling grid or associated drop ceiling components or fixtures.
- c. Contractor shall provide a minimum of 10 feet slack or service loop in the horizontal telecommunications room on each terminated copper horizontal permanent link, to be stored on the wall backboard using appropriate mounting fixtures built to that purpose (i.e. D-rings).
- d. Contractor should consult project-specific documentation or their Canyons Schools project liaison for other mounting methods where wall mount is not an option.

##### 2. Metal Conduit

- a. Cable in horizontal runs in classrooms shall be routed and contained in metal conduit.
- b. No conduits shall have greater than a 30% fill per manufacturer fill charts. Contractor shall size conduit large enough to accommodate 50% growth. (i.e., conduit for 4 cables shall be sized to accommodate 6 cables) Contractor is responsible for bringing to the attention of Canyons School District Information Technologies project manager any insufficiently sized conduit or cable pathways in project documentation.

##### 3. Electrical Boxes

- a. Contractor shall size work area boxes to accommodate no less than 12" cable slack on each terminated Category 6a UTP cable run.
- b. Contractor shall use double-gang boxes behind single-gang faceplates if necessary for storing 12" cable slack (service loop) without violating minimum bend radius of 4X cable outer diameter.
- c. In work areas where slack storage in cable box violates cable bend radius, Contractor should pull slack into ceiling and affix with plenum rated hook and loop (re-enterable) cable ties. If drop ceiling is present. Cable shall under no circumstances be laid upon drop ceiling.

##### 4. Copper Jacks – Category 6A

- a. Category 6a, eight-position copper jacks shall be Panduit Mini-Com® TX6A™ 10Gig UTP, Leviton/Berk-Tek, or Canyons School approved equal Jack Modules.



- b. Category 6a jacks at the work area shall be color black unless otherwise indicated in project-specific documentation.
- c. Category 6a jacks shall further meet the following requirements:
- Exceed ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA standards
  - Meet requirements of IEEE 802.3af and IEEE 802.3at for PoE applications
  - Be 100% tested to ensure NEXT and RL performance and be individually serialized for traceability.
  - Color-coded, keyed jack modules mechanically and visually distinguish connections to prevent unintentional mating with unlike keyed or non-keyed modular plugs accommodating more discrete networks.
  - Include MaTriX split foil tape to suppress the effects of alien crosstalk, allowing 10 Gb/s transmission even in high density 48-port, 1RU patch panels.
  - Utilize patent-pending enhanced Giga-TX™ Technology for jack terminations which optimizes performance by maintaining cable pair geometry and eliminating conductor untwist.
  - Meets ANSI/TIA-1096-A contacts plated with 50 microinches of gold for superior performance.
  - Rated for 2500 cycles with IEEE 802.3af / 802.3at and proposed 802.3bt type 3 and type 4
  - Require no punch down tool required; termination tool (EGJT) ensures conductors are fully terminated by utilizing a smooth forward motion without impact on critical internal components for maximum reliability.
  - Have available a high-volume “gun-style” optional termination tool (TGJT) that reduces termination time by 25% and is ideal for high volume installations.
  - Have guaranteed ability to be re-terminated a minimum of twenty times without measurable degradation of performance.
  - Employ a blue termination cap to designate Category 6A performance at a glance and provides positive strain relief; help control cable bend radius and securely retain terminated cable.
  - Have range to terminate 4-pair, 22 – 26 AWG, 100 ohm, solid or stranded twisted pair cable.
  - Utilize a universal termination cap is color-coded for T568A and T568B wiring schemes for flexibility across installations.
  - Accept 6 and 8-position modular plugs without damage to conductor pins.
  - Identified options that include optional labels and icons.
  - Be compatible with Mini-Com® Modular Patch Panels, Faceplates, and Surface Mount Boxes.
  - Have available optional RJ45 blockout device that blocks out unauthorized access to jack modules and potentially harmful foreign objects, saving time and money associated with data security breaches, network downtime, repair, and hardware replacement
  - Have an optional dust cap keeps out dust and debris while not in use



- d. See Appendix A for part numbers.

## 5. Flush Mount Equipment Outlets (Faceplates)

- a. When adding horizontal cabling to existing facilities Brownfield within Canyons School District, Contractor shall match the existing cable plant in regards to color of existing raceway and faceplates.
- b. Unless otherwise instructed on project-specific documentation, all Canyons greenfield (new) projects shall use Panduit Mini-Com® Classic Series sloped faceplates, Leviton faceplates with label cover, of international white (IW) color, or a Canyons School District approved equal.
- c. Plastic sloped faceplates shall be in 4 or 6-hole single-gang configuration, or double-gang 8 hole configurations as needed for the number of cables at that workstation.
- d. Plastic faceplates for greenfield applications shall further have the following properties:
  - Accept Mini-Com® or Leviton Modules for STP and UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
  - Include label/label covers for easy port identification.
  - Replacement label/label covers available.
  - Optional icons available.
- e. Some greenfield projects for Canyons School District will require Panduit Mini-Com® or Leviton stainless steel faceplates with label fields, in single-gang 4-hole or double-gang 8-hole configurations, (or Canyons approved equivalent). See project-specific documentation or consult the Canyons project liaison if clarification on faceplate type is needed.
- f. Stainless faceplates, where used, shall meet the following criteria:
  - Accept Mini-Com®, Leviton Modules for STP and UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
  - Include label/label covers for easy port identification.
  - Replacement label/label covers available.
  - Impact-resistant 304 stainless steel suitable for light industrial environments.
- g. Contractor shall use blank inserts to reserve space on any unused positions (holes) in plastic or stainless plates.
- h. See Appendix A for part numbers.

## 6. Horizontal Copper Cable

- a. Inside 4 pair horizontal cable for Canyons School District facilities shall be CAT6a high-performance, jacketed, plenum rated General Cable, or Canyon School approved equivalent. Jacket colors shall be as follows: green to security cameras, gray to non-networked infrastructure [e.g., lighting controls, motion/fire sensors], blue to all network data drops, and yellow to A/V controllers and devices.



- b. In addition, inside 4 pair Category 6a UTP copper cable must meet the following mechanical and performance criteria:
- UL Listed CMP-LP, UL Limited Power (LP) Certified
  - Meet TIA TSB-184-A/ IEEE P802.3bt "LP" rating for Limited Power cable requirements
  - Exceeds requirements of ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA channel standards.
  - Exceeds requirements of ANSI/TIA-568-C.2 and IEC 61156-5 Category 6A component standards.
  - Meets requirements of IEEE 802.3af and IEEE 802.3at for PoE applications.
  - Meets requirements of ANSI/TIA 862
  - Meets requirements of ICEA S-116-732
  - Third party tested to comply with ANSI/TIA-568-C.2.
  - Cable diameter: Plenum 0.250 in nominal.
  - Installation temperature range: (0°C to 60°C).
  - Operating temperature range: (-20°C to 90°C).
  - Include Encapsulated Isolation Wrap to suppress the effect of alien crosstalk allowing 10 Gb/s transmission, while minimizing cable diameter.
  - Descending length cable markings enable easy identification of remaining cable which reduces installation time and cable scrap.
- c. Outside run 4 pair horizontal cable for Canyons School District facilities shall be high-performance, black jacketed, General Cable CAT6a OSP cable constructed for wet or outside-plant applications, or Canyon School approved equivalent.
- d. In addition, outside run 4 pair Category 6a UTP copper cable must meet the following mechanical and performance criteria:
- Outdoor horizontal cable drops shall use 23 AWG category 6A 4-pair UTP outdoor cable.
  - Cable jacketing shall be black.
  - Cable shall be intended for outdoor installation in buried conduit or as aerial cable.
  - Installation temperature range (-30 to +60C)
  - Operation temperature range (-45 to +80C)
  - The cable core shall be Gel-filled construction to prevent moisture migration in underground and wet applications.
  - OSP type cables shall have a nominal diameter less than or equal to .365"
- e. See Appendix A at the end of this document for cable part numbers.

## 7. Distributor I (Horizontal Patch Panels)





- a. Canyons School District Information Technologies copper patch panels in the horizontal patch fields shall be flat 1 RU or 2 RU Panduit modular Mini-Com® or Leviton Modular Faceplate Patch Panels, or approved equivalent as needed to accommodate UTP cable quantity.
- b. Modular patch panels shall be standard density of 24 ports per rack unit.
- c. Contractor shall populate modular panels with black Panduit or Leviton Category 6a jacks, or approved equivalent as described elsewhere in this document. See Appendix A for part numbers on jacks to go with modular patch panels.
- d. Contractor shall pair modular patch panels in alternating fashion with workgroup switches allowing for use of 12" Category 6a patch cords for one-to-one switch patching, eliminating the need for horizontal cable managers between the switches and patch fields. See illustration below for example of one-to-one switch patching strategy.



**Example of one-to-one switch patching**

- e. Patch Panels shall further meet the following criteria:
  - Have release snap feature on faceplate to allow front access to installed modules.
  - Accept Mini-Com®, Leviton or Canyons School approved equal Modules for UTP, fiber optic, and audio/video, which snap in and out for easy moves, adds, and changes.
  - Be available in label versions available for easy port identification, with replacement label/label covers available.
  - Mount to standard EIA 19" racks or 23" racks with optional extender brackets.



- Be available in angled patch panels to facilitate proper bend radius control and minimize the need for horizontal cable managers.

f. For detailed part numbers see "Appendix A" at the end of this document.

## 8. Copper Patch Cords

- a. Copper patching of Category 6a links in Canyons School District facilities shall use blue Panduit 28 awg "small diameter" slim patch cords, Leviton High-Flex HD6, or Canyons School approved equal.
- b. Security camera patch cables shall be green. If other color patch cords are needed to designate particular applications, see Appendix A for instructions on changing patch cord colors.
- c. In telecommunications rooms utilizing individual workgroup switches, Contractor shall alternate patch panels with switches, using 12" patch cord lengths in "one-to-one" switch patching strategy as indicated in the patch panel section of this specification (above).
- d. Core (chassis) switches shall utilize whatever length patch cords necessary for an efficient and neat, workmanlike installation.
- e. Small diameter patch cords shall have the following characteristics:
  - Cable diameter not more than 0.185 in. (4.7mm) nominal.
  - Category 6A/Class EA channel and component performance.
  - Exceeds all ANSI/TIA-568-C.2 Category 6A and ISO 11801 Class EA electrical performance requirements for all frequencies from 1 to 500 MHz
  - FCC and ANSI compliance: Meets ANSI/TIA/EIA-1096-A; contacts plated with 50 micro inches of gold for superior performance.
  - IEC compliance: Meets IEC 60603-7
  - PoE compliance: Meets IEEE 802.3af and IEEE 802.3at for PoE applications in bundle sizes up to 48 cables.
  - Operating temperature: 14°F to 140°F (-10°C to 60°C).
  - Storage temperature: -40°F to 158°F (-40°C to 70°C).
  - Plug housing: UL94V-0 rated clear Polycarbonate.
  - Contacts: Gold plated phosphor bronze.
  - RoHS compliance: Compliant.
  - Flammability rating: CM/LSZH dual rated.
- f. Note: These patch cords utilize 28 AWG conductors which do not meet the 22 to 26 AWG conductor size of patch cable referenced in ANSI/TIA-568-C.2, resulting in an increased attenuation de-rating value of 1.9. These patch cords support 96-meter channels that include 90-meter permanent links. And 6 meters of patch cord, or supports 93-meter channels with 10 meters of patch cords included in the channel.
- g. See Appendix A for part numbers.



## 9. Surface Mount Raceway

- a. On brownfield installations, Contractor shall match raceway to that already installed in the facility unless instructed otherwise in project-specific documentation.
- b. On greenfield installations where environment (cinder block walls) or project documentation requires cable to be surface-mounted in the work area; horizontal cable shall be routed through Panduit LD10 International White (color), Leviton plastic latching-duct raceway or Canyons approved equivalent.
- c. Areas requiring power and data be run through single raceway with partition (separator), Contractor shall utilize Panduit LDP10, Leviton, or Canyons School approved equal raceway or T-70 raceway system as needed to accommodate all cable **with not more than a 30% fill according to manufacturer fill tables.**
- d. **No raceway shall have greater than 30% fill upon installation, providing room for at least 50% growth in additional cables: i.e., a work area requiring 4 cables, raceway shall be sized to hold 6.**
- e. Contractor is responsible that raceway installation includes all associated fittings, drop ceiling fittings, couplers and 1" control-bend-radius fittings where appropriate.
- f. Contractor shall not rely on the pressure sensitive adhesive foam to mount raceway, but rather use adhesive to hold raceway in place while screwing down the raceway to the structure beneath using anchors appropriate to the wall type at intervals not to exceed 2 ft (24 inches).
- g. Standard LD-10 Panduit, Leviton or Canyons School approved equal raceway shall have the following features:
  - For routing data and low voltage cabling.
  - One-piece hinged design allows cables to be laid in.
  - Factory applied adhesive backing speeds installation.
  - FT4 rated.
  - Terminates using surface mount outlet box solutions, Panduit Mini-Com, Leviton or Canyons School approved equal surface mount boxes.
- h. Installations requiring raceway shall use the same faceplates used in flush-mount applications as specified in this document, mounted on Panduit "JB1", Leviton surface boxes, or Canyons approved equivalent. Contractor shall not rely on adhesive-backing to hold surface boxes in place, but must use appropriate wall anchors for firm, permanent installation.
- i. Some Canyons facilities may require metallic raceway systems. Consult project-specific documentation or the Canyons School District project liaison if clarification on raceway type is needed.
- j. See Appendix A at the end of this document for part numbers.



---

## C. Cabling Subsystems II - Intrabuilding Backbone Fiber

---

### 1. Fiber Cable

- a. On additions to existing Canyons School District fiber cable plant (brownfield projects), Contractor shall match existing fiber and connector types.
- b. In new (greenfield) Canyons School District projects, backbone fiber running between telecommunications rooms on the same floor, or between floors in the same building shall be General Cable indoor/outdoor, Berk-Tek, plenum-rated, armored, 50 micron cable of 12 or 24 strand count, or Canyons approved equal. See "Substitution Policy" for mandatory process if offering equivalents.
- c. Contractor shall install OM4 version of cable described for all telecommunications spaces that are spaced 300 meters or closer for use with 10G Ethernet. Note this will be almost all instances in Canyons School facilities.
- d. Fiber optic cable shall further have the following features:
  - Product Construction: Fiber: 4–144 fibers, 900 µm tight buffer, Color-coding per TIA/EIA 598 B.
  - Overall Strength Member: Water-swellaable aramid fiber yarn
  - Inner Jacket: Flame-retardant compound.
  - Armor: Interlock aluminum.
  - Outer Jacket: Flame-retardant compound, UV-resistant black jacket, Sequential footage markings/
  - Features: Interlock armor provides outstanding mechanical protection, Interlock armor is flexible and easy to use tight buffer provides individual fiber protection, sub-units are numbered for identification.
  - Performance: Temperature: Storage -40°C (-40°F) to +70°C (+158°F), Installation 0°C (+32°F) to +50°C (+122°F), Operating -20°C (-4°F) to +70°C (+158°F).
  - Minimum Bend Radius: 20 X OD—Installation, 10 X OD—In-Service.
  - Maximum Crush Resistance: 1,500 lbs/in (2,627 N/cm).
  - Applications: Harsh premises environments requiring heavy-duty protection, outdoor use in ducts and underground conduits.
  - ETL Type OFCP for installation in any premises location when installed in accordance with NEC article 770.154 and 770.179.
  - Compliances: ETL Listed Type OFCP, CSA FT6, TIA 568 C.3, ICEA S-104-696, GR-409, RoHS Compliant Directive 2002/95/EC.



- e. Contractor shall bond to ground armor from fiber backbones at both ends as indicated in the grounding section of this document; using armored cable grounding kits listed in the Appendix A grounding section.
- f. See Appendix A for all fiber cable part numbers.

## 2. LC Fiber Connectors

- a. All tight-buffered indoor fiber trunks shall be terminated using Panduit LC OptiCam®, Leviton FastCam Fiber Optic Connectors or Canyons approved equal.
- b. LC cam connectors shall further have the following properties:
  - Be a TIA/EIA-604 FOCIS-10 compatible connector that exceed exceeds TIA/EIA-568-B.3 requirements.
  - Have connector backbone and boot colors that follow TIA/EIA-568-C.3 suggested color identification scheme.
  - Have insertion loss: 0.3dB average (multimode and singlemode).
  - Have return loss: >26dB (10Gig multimode), >20dB (multimode), >50dB (singlemode).
  - Be a spring-loaded "Senior" rear pivot latch LC connector.
  - Be a pre-polished cam style termination for in less than half the time of field polish connectors.
  - Have patented re-termination capability provides yield rates approaching 100%.
  - Feature a factory pre-polished fiber end face eliminates time-consuming field polishing to reduce installation costs, labor, scrap and the number of tools required.
  - Be cam activated, with fiber and buffer clamp mechanisms that provide superior fiber and buffer retention with less sensitivity to fiber tensile loading.
  - Utilize OptiCam® or FastCam Termination Tools that simplifies tooling and termination, and virtually eliminates operator error by providing a visual indication of proper termination after the cam step has been completed.
  - Have a range of cable retention boot assemblies that consistently provide higher than industry standard cable retention.
  - Include a non-optical disconnect that maintains data transmission under tensile loads for jacketed cable.
  - Have ability to accept 900µm tight-buffered fiber with included boot(s), and accept 1.6mm – 2.0mm and 3.0mm jacketed cable with available OptiCam® Cable Retention Boot Assemblies (ten per package).
- c. See Appendix A for part numbers on LC fiber connectors.

## 3. Fiber Enclosures

- a. Fiber cable terminations shall be contained in 1 RU, or 2 RU Panduit FCE series, Leviton rack mount fiber enclosures, or Canyons approved equal.
- b. Contractor shall select enclosure size as needed for the number of fibers projected to be in that telecommunication space when fully populated. The average horizontal telecom room (Distributor 1) will



not require more than one single RU fiber enclosure, which will house up 48 OM3 fiber strands.

- c. Contractor shall fill any unused enclosure space with a blank fiber adapter panel (FAP).
- d. FCE enclosures shall further have the following properties:
  - Be able to hold Panduit QuickNet™ Fiber Optic Cassettes, Opticom® Fiber Adapter Panels, or splice modules, Leviton or Canyons School approved equal.
  - Have a slide-out, tilt-down drawer to provide full front access to all fibers and cables.
  - Employ integral bend radius control and cable management appliances for fiber optic patch cords.
  - Have rear cable management for proper slacking/spooling of trunk cable break-outs and interconnect cables.
  - Have multiple trunk cable entry locations and include fiber optic cable routing kit (grommets, cable ties, spools, strain relief bracket, and ID/caution labels) for different installation configurations.
- e. See Appendix A for part numbers.

#### 4. Fiber Adapter Panels

- a. FCE fiber enclosures shall be populated with OM3 fiber adapter panels containing 6 duplex fiber adapters.
- b. Contractor is responsible to blank out any enclosure spaces where adapter panels are not used.
- c. Adapter panels shall further have the following features:
  - Loaded with TIA/EIA-604 FOCIS-10 compatible adapters.
  - Exceed TIA/EIA-568-B.3 requirements.
  - Adapter housing colors follow TIA/EIA-568-C.3 suggested color identification scheme.
  - Snap quickly into the front of all Opticom® components
  - LC fiber adapter panels are Sr/Jr. to conserve enclosure space.
  - Accept FOCIS-10 compatible senior LC connectors at either end and FOCIS-10 junior LC connectors at the inside end for behind the wall applications.
  - Both ends accept FOCIS-10 compatible senior LC connectors.
  - Junior end also accepts FOCIS-10 compatible junior (fixed ferrule/springless) LC connectors.
  - Choice of phosphor bronze or zirconia ceramic split sleeves to fit specific network requirements; zirconia ceramic split sleeves are recommended for OM4/OM4 multimode and OS1/OS2 single mode applications.
  - Every adapter is laser marked with Q.C. number to assure 100% traceability.
  - LC adapters are also available in QuickNet™ Fiber Optic Cassettes, Leviton Opt-X fiber modules





and cassettes or Canyons School approved equal.

- d. See Appendix A for fiber adapter panels and blank adapter panels.

#### 5. Fiber Patch Cords

- a. Fiber patch fields within Canyons School District facilities shall utilize Leviton, Panduit "push/pull" fiber jumpers (fiber patch cords) or Canyons School approved equal that have the following properties:
- Push-Pull LC Duplex Fiber Optic Patch Cords shall feature the push-pull strain relief boot and duplex clip, to allow users easy accessibility in tight areas when deploying very high density LC patch fields.
  - Jumpers shall be available in OM3, OM4 and single-mode and be available in in riser (OFNR), plenum (OFNP), and low smoke zero halogen (LSZH) rated jacket materials.
- b. See Appendix A for part numbers.

#### 6. Category 5E, 25-Pair Building Controls Backbone Cable

- a. One gray jacketed, plenum rated, 25 pair Cat 5e cable shall be installed from the MDF to reach every individual IDF to serve as backbone for building controls.
- b. 25 Pair 5E cable shall be General Cable or Canyons approved equivalent and shall meet the following mechanical and performance criteria:
- Conductors: • 25 pairs of 24 AWG solid bare annealed copper.
  - Insulation: Non-Plenum: Polyolefin Plenum rated Fluoropolymer,
  - Color Code: Standard except no bandmarking; only solid colors.
  - Rip Cord: Applied longitudinally under jacket.
  - Jacket: Plenum: Low-smoke, flame-retardant PVC.
  - Separator: Plenum: Core filler.
  - Nominal Cable Diameter: .5".
  - Nominal Cable Weight (lbs/1000 ft): 160 lbs.
  - Temperature Rating Centigrade (Installed): 0 to +60.
  - Temperature Rating Centigrade (Operation): -20 to +75.
- c. 25 pair 5E control backbone shall be terminated on wall mount 100 Pr 110 blocks with C5 clips at the MDF end and on a 24-port patch panel in the IDF end.
- d. The patch panel in the IDF end is to be installed below the fiber enclosure at the top of the rack with one available rack unit reserved below it.
- e. 5E patching in the IDF shall use white jacketed small diameter Panduit, Leviton 5E patch cords or Canyons approved equivalent.



- f. Copper backbone must likewise be installed in satellite buildings. Consult project-specific documentation or Canyons project liaison if clarification is needed.
- g. See Appendix A for complete part numbers for fiber and copper backbone cable and termination hardware.

## **D. Cable Pathways**

---

### **7. J-Hooks**

- a. Bundles of 120 Category 6a cables or less may be required to be routed above ceilings using J-hooks. Check project documentation for clarification.
- b. J-hook systems used by Canyons School District Information Technologies shall be Panduit "J-Pro" series, Leviton or School approved equivalent.
- c. Contractor installing J-hook systems shall space them no more than 5 feet apart as per TIA 569-C standard.
- d. Contractor is responsible for proper sizing of J-hook systems based upon cable count and manufacturers recommendations for fill, with new J-hooks to have not more than 30% fill per manufacturer's fill charts based upon projected worst case future bundle size.
- e. If J-hooks are deemed too small by above criteria, Contractor shall bring this to the attention of Canyons School District for resolution in writing. J-hook pathways that will not have sufficient capacity should be replaced in the design with the proper sized basket tray for future cable additions and flexibility.
- f. J-hook systems used by Canyons School District Information Technologies shall have the following properties:
  - Patented design provides complete horizontal and vertical 1" bend radius control that helps prevent degradation of cable performance.
  - UL 2043 and CAN/ULC S102.2 listed and suitable for use in air handling spaces.
  - Pre-riveted assemblies allow for attachment to walls, ceilings, beams, threaded rods, drop wires and underfloor supports to meet requirements of a variety of applications.
  - Wide cable support base prevents pinch points that could cause damage to cables.
  - Cable tie channel allows user to easily install 3/4" (19.1mm) Tak-Ty ® Cable Ties to retain cable bundle.
  - Durable non-metallic J Hook materials provide the ability to manage and support a large number of cables.
  - Material: Black Nylon 6.6 J Hook with metal attachments.
- g. See Appendix A for part numbers.





---

## **E. 19" Racks and Rack-mount Cable Managers**

---

### **1. Four-Post Communications Racks**

- a. Contractor shall mount IT equipment and patching systems on threaded rail 7 foot, 4-post racks, unless forced to use 2-post due to telecommunications room space constraints.
- b. All racks shall utilize threaded hole rails. Cage nut rails are banned within Canyons facilities and will not be accepted.
- c. 4-post racks shall be of 30", 36", or 41.5" depth as needed by mounted equipment. Contractor is responsible for confirming proper depth to be used.
- d. 4-post racks shall be the 4 Post Cable Management Rack System or Canyons School District approved equivalent, and must have the following features:
  - Independent adjustable front and rear mounting rails can be adjusted while the rack is secured to the floor.
  - Printed rack space identification on all equipment rails allows for quick location of rack spaces, speeding installation of rack mount items (shipped numbers up per TIA-606B specifications; can be set to number down by flipping the rails).
  - Rack is UL listed for 2,500 lbs. load rating.
  - Rear rail construction provides a clear ventilation path for side ventilated switches.
  - Multiple mounting holes in top flanges for securing ladder rack.
  - Weld nut construction eliminates the need for a second wrench increasing speed and ease of assembly.
  - Multiple mounting locations for vertical power strips on any of the four posts or on the adjustable mounting rails.
  - PatchRunner™ and NetRunner™ Vertical Cable Managers mount directly to the 4 post rack at any of the four corners to provide a flexible end-to-end cable management solution.
  - Paint piercing washers included to electrically bond rack for simplified grounding.
- e. See Appendix A for part numbers.

### **2. Two-post Communications Racks**

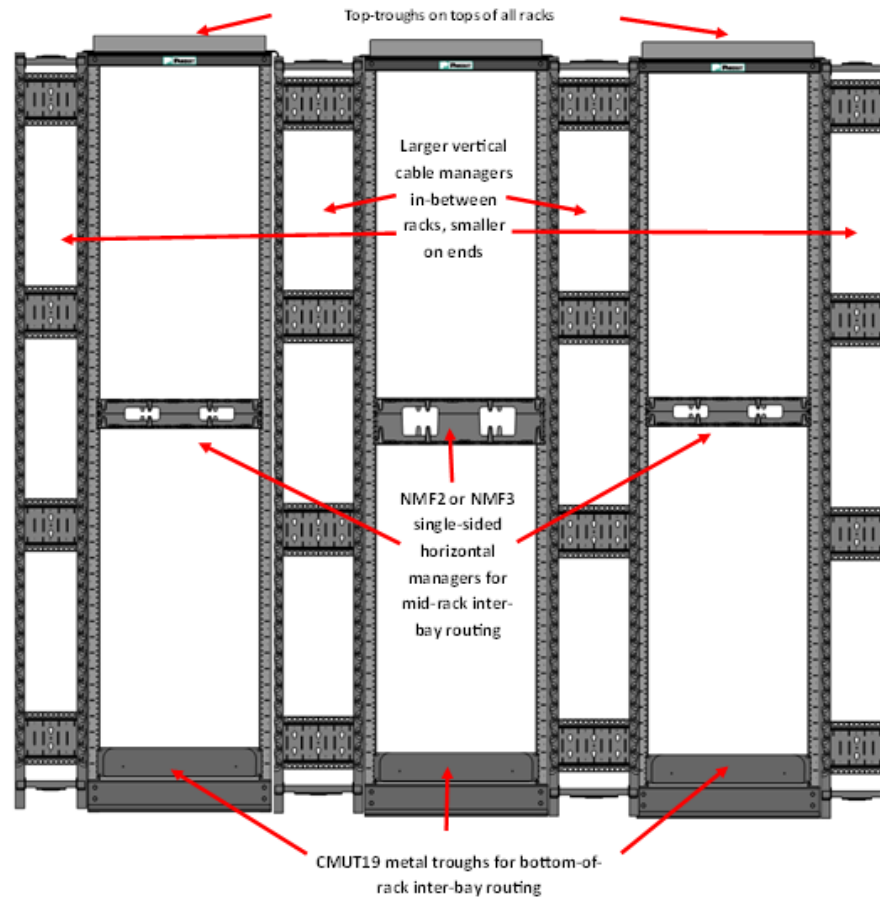
- a. Contractors may use 19", 2-post communications racks only in telecommunication rack spaces too small to use 4-post racks. Prior notification must be given to the CSD Director of IT.
- b. 2-post racks, when necessary, will be Panduit or Leviton black-powdered aluminum (or Canyons approved equivalent) and have the following properties:
  - 19" EIA rack, aluminum.
  - Dimensions: 96.0"H x 20.3"W x 3.0"D (2134mm x 514mm x 76mm).



- 
- Rack units numbering up from bottom to allow quick and easy location of rack mount items
  - UL listed for 1,000 lbs. load rating.
  - Double-sided #12-24 EIA universal mounting hole spacing with 24 #12-24 mounting screws included.
  - Accepts all Panduit or Leviton cable management and patch panel products in addition to any industry standard 19" components or Canyons School approved equal.
  - Includes paint piercing washers for assembly to assure electrical continuity between components as per TIA 607-B Bonding and Grounding Standard.
- c. In telecommunications rooms with multi-bay rack rows configured such that patching will take place between racks, Contractor is responsible to include in design interbay routing pathways at the top, middle and bottom of each bay to provide efficient and neat interbay routing.
- d. Interbay routing shall be provided in the form of top troughs, interbay mid-rack path and flanged shelf at the bottom. (See "Illustration of Interbay Routing" below).

### Illustration of Inter-bay Routing in Rack Systems

(Note: Doors left off vertical and horizontal managers for clarity)



- e. For bottom-of-rack interbay routing where cable quantities exceed capacity of CMUT19 troughs, Contractor shall substitute 4RU trough CMLT19.
- f. All racks shall be outfitted with a vertical grounding busbar along one rail, with all equipment bonded to ground according to TIA 607-B Bonding and Grounding Standard. See Bonding and Grounding section of this document for details.
- g. See Appendix A for part numbers.

### 3. Rack-mounted Cable Management – Vertical Managers

- a. Vertical cable managers shall be PatchRunner™ high capacity vertical Cable management system in sizes 6" wide, 8" wide, 10" wide and 12" wide, Leviton vertical cable management systems or Canyons School approved equivalent.
- b. Contractor will use double-sided (front and back) vertical managers on fronts of 4-post racks.
- c. All vertical cable managers shall have metal dual hinged doors.



- d. Contractor shall choose vertical cable manager width according to manufacturer's fill tables to not represent more than a 35% fill at installation based on projected worst-case density when racks are fully populated.
- e. Vertical cable managers shall have the following features:
  - High density minimizes area required for network layout, freeing up valuable floor space.
  - Allows mounting of many standard EIA 19" accessories, such as patch panels, vertically in the manager.
  - Ventilated sidewalls provide maximum airflow for equipment cooling.
  - Snap on finger sections can be removed to improve airflow, and breakaway fingers allow routing of large cable bundles.
  - Large finger spacing accommodates up to 48 Cat6A cables.
  - Optional sure-close dual hinged metal doors provide easy access to vertical pathway and provide visual and audible feedback on closure.
  - Available in 7-foot version.
- f. See Appendix A for part numbers.

#### 4. Rack-mounted Cable Management – Horizontal Managers

- a. One-to-one switch patching strategy largely eliminates the need for horizontal cable managers, but there still may be instances requiring them. One example is in the network core where chassis switches are used.
- b. For these areas requiring horizontal cable managers, Contractor shall use double-sided NetManager™ high capacity horizontal cable managers, Leviton horizontal cable managers or Canyons approved equal having the following features:
  - Innovative inset fingers slope inward toward back of managers offering unobstructed access to network cabling for easier moves, adds, and changes.
  - Large front finger openings easily accommodate Category 6a and 10 G/b E cables, speeding installation and reducing maintenance costs.
  - Rear cable management finger spacing utilizes open D-rings for greater accessibility.
  - Can be used to create large capacity horizontal pathways for routing cable.
  - Patented front and rear dual hinged cover allows cable access without removing cover.
  - Curved surfaces maintain cable bend radius.
  - Pass-through holes allow for front to rear cabling.
  - Built in cable retainers hold cable in place for easy moves, adds, and changes.
  - Mount to 19" EIA racks and cabinets.



- Covers, #12-24 and M6 mounting screws included.
  - Design fits flush to the front of the NetRunner ® High Capacity WMPVHCF45E and WMPVHC45E Vertical Managers or Leviton vertical cable managers.
- c. See Appendix A for part numbers.

## **F. Cable Accessories**

---

### **1. Cable Ties**

- a. Cable bundles on racks and in pathways shall be bundled with re-enterable hook and loop cable ties that come in continuous rolls.
- b. Contractor is responsible for using plenum hook and loop ties in air-return spaces.
- c. See Appendix A for part numbers.

### **2. Physical Security Devices**

- a. Some portions of Canyons School District networks require additional physical security devices. These take three forms:
- b. Devices that block-out copper and fiber ports in patch fields and faceplates that require a special tool for removal.
- c. Devices that lock-in copper patch cords and require a special tool for removal of those patch cords.
- d. Devices that temporarily or permanently block USB ports on laptops and computers.
- e. Areas where such devices are required will be called out in the project documentation.
- f. See Appendix A for part numbers.

## **G. Communications Grounding Network**

---

### **1. General**

- a. Contractor is responsible for bonding to ground all newly placed equipment and installed racks or cabinets per the TIA 607-B Standard.

### **2. Room Busbars**

- a. All Telecommunications spaces and distributor rooms shall have installed an appropriately sized wall-mount busbar with BICSI hole spacing that bonds to the building bonding backbone.
- b. See Appendix A for appropriate room telecommunications grounding busbar.

### **3. Rack and Equipment Grounding**

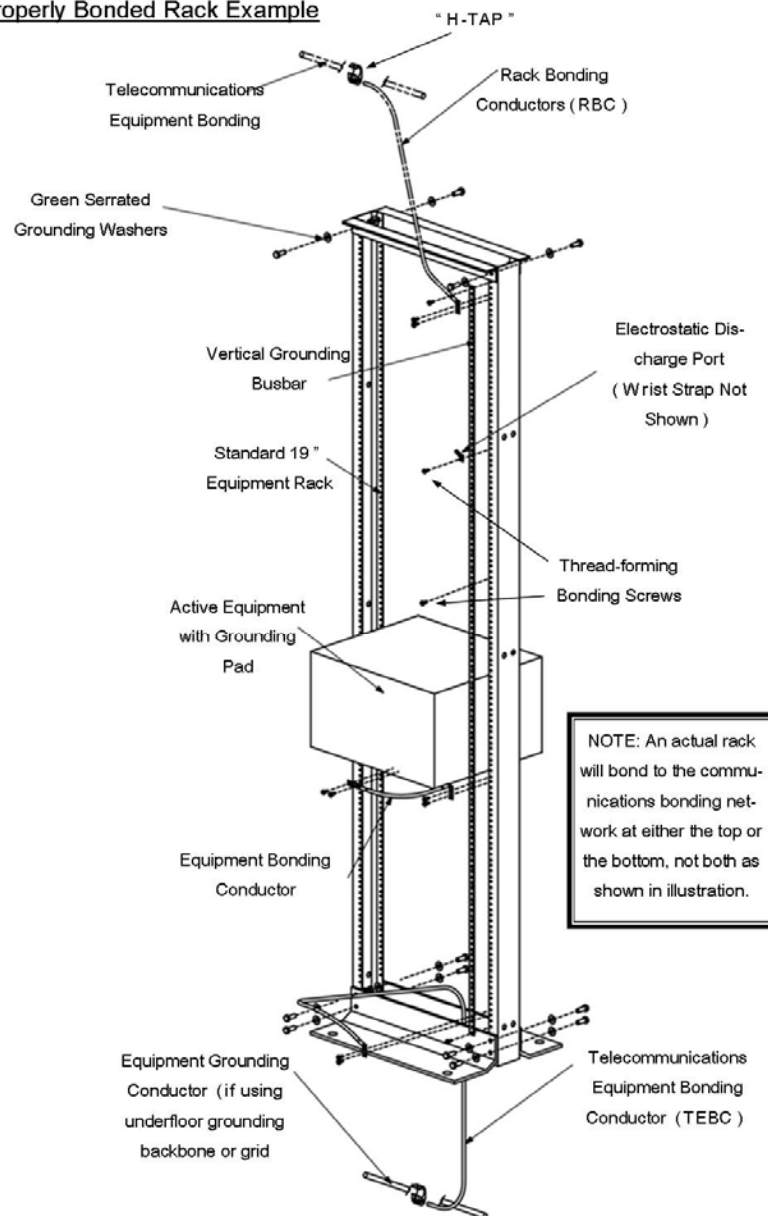
- a. Contractor is responsible for properly grounding all network equipment, racks and cabinets and bonding



- them to the wall mounted busbars as described in the **TIA 607-C** standard.
- b. All newly installed racks and cabinets shall have installed a vertical busbar mounted along one equipment rail to serve as a clean, low-resistance bonding place for any equipment not equipped with a designated grounding pad.
  - c. Smaller equipment without an integrated grounding pad shall be bonded to the vertical busbar through the use of a thread-forming grounding screw that is anodized green and includes serrations under the head to cut through oxidation or paint on the equipment flange.
  - d. Larger equipment (chassis switches) with a designated grounding terminal shall be bonded to the vertical busbar with an EBC (equipment bonding conductor) kit built to that purpose.
  - e. Contractor shall take care to clean (wire brush, scotchbrite pads) any metallic surface to be bonded down to bare metal and apply a film of anti-oxidation paste to the surfaces prior to effecting the bond.
  - f. All bonding lugs on racks and busbars shall be of two-hole irreversible compression type. Mechanical lugs and single-hole lugs will not be accepted and shall be removed and replaced at Contractor's expense.
  - g. Every rack or cabinet shall have an individual bonding conductor into the grounding network, serially connecting (daisy chaining) of racks is expressly forbidden and will not be accepted.
  - h. Rack Bonding Conductors (RBC) may tap into an overhead or under floor aisle ground, or may run to the wall-mounted grounding busbar in smaller Telecommunications rooms containing 5 racks or less.
  - i. A minimum of every other rack or cabinet shall be outfitted with a properly installed and bonded ESD (electro-static discharge) port along with a wrist strap and lead to be used by any technicians servicing network equipment. On four post racks and cabinets, these ESC ports and straps shall be provided on front and back to be accessible and able to reach any active equipment needing servicing.
  - j. Armored cables shall be properly bonded to the earthing system on both ends with a kit built to that purpose.
  - k. For examples of rack grounding, refer to the illustration below:



Properly Bonded Rack Example



END OF SUB-SECTION SECTION III



---

## H. Communications Entrance Facilities

---

### 1. General

- a. All entrance facilities shall be installed, grounded and bonded per applicable building, fire and electrical codes
- b. A minimum of qty 1 (one) 4" metal conduit shall extend from the Canyons School District owned handhole/vault at the property line to the MDF.
- c. A minimum of qty 1 (one) 4" conduit (item b – above) shall contain qty 3 (three) 1.25" innerduct from the handhole to the MDF.
- d. All innerduct shall contain a secured pull string/tape.

## IV. Network Labeling

---

### A. General Requirements

---

1. When labeling any Canyons School District Information Technologies network system, whether existing or new, Contractor shall always adhere to the following requirements:
  - a. Contractor shall, wherever possible pre-print labels using Panduit Easy-Mark software and laser jet printer, Leviton or Canyons approved equivalent.
  - b. The Panduit PanTher (LS8E) hand-held thermal transfer printer, Leviton or Canyons approved equivalent shall be used on site to print labels that were unanticipated, or that become damaged in application.
  - c. This labeling strategy shall, at a minimum, clearly identify all components of the system: racks, cables, panels and outlets, grounding, pathways and spaces like telecommunications rooms.
  - d. Racks and patch panels shall be labeled to identify the location within the cable system infrastructure.
  - e. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
  - f. All label printing will be machine generated by either hand-held labeling systems or computer generated using programs and materials built specifically for communications labeling.
  - g. Hand written labels will not be accepted and must be remedied at Contractors expense.
  - h. Cabling system labels shall utilize materials designed to outlast the cabling elements to which they attach. Office quality labels will not be accepted.
  - i. Cable labels shall be self-laminating, appropriately sized to the outside diameter of the cable and placed within view at the termination point on each end.
  - j. Outlet, patch panel and wiring block labels shall be installed on, or in, the space provided on the device.
  - k. Machine-generated labels shall be installed behind the clear lens or cover on any device that provides such an option.





- l. All labels will be permanently affixed to installed cables, patch panels, racks, cabinets, and enclosures.
- m. Labels shall be legible and placed in a position that insures ease or visibility. Label type must be as listed in Appendix A - Materials section at the end of this document.
- n. Conduit shall be marked indicating the identification of the cable within.
- o. All cabling added to existing "legacy" installations shall follow the labeling convention in place at that location.
- p. All labeling of installed cabling in new (greenfield) projects shall satisfy all requirements of TIA 606-B, or be modified as indicated in the project specific documentation.

END OF SUB-SECTION IV

## V. Testing and Acceptance

### A. General

---

- 1. All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance under installed conditions.
- 2. All copper pairs or optical fibers of each installed cable shall be tested and verified prior to system acceptance.
- 3. Any defect in the cabling system performance or installation including but not limited to cable, connectors, feed through couplers, patch panels, and connector blocks shall be repaired or replaced in order to ensure 100% useable conductors or fibers in all cables installed.
- 4. All cables shall be tested in accordance with this document, the ANSI/TIA Standards, the PANDUIT® Certification Plus or PanGen™ System Warranty, Leviton/Berk-Tek Limited Lifetime Warranty, or Canyons School approved equal guidelines and best industry practice.
- 5. If any of these are in conflict, the Contractor shall bring any discrepancies to the attention of the project team for clarification and resolution.

#### a. Copper Link Testing

---

- 1. All twisted-pair copper cable links shall be tested for compliance to the requirements in ANSI/TIA 1152 and ANSI/TIA 568-C.2 for the appropriate Category of cabling installed using a test unit meeting a minimum IEC IIIe level of accuracy.
- 2. All testers used must have been factory calibrated by the manufacturer within one year of use or according to factory calibration recommendations, whichever is the more stringent.
- 3. Contractor shall set references according to manufacturer's recommendation prior to each day's testing and reset references anytime tester is left unused for more than two hours.



4. For warranty purposes, Contractor shall perform the appropriate Permanent Link test. Channel Link testing is rendered void by the movement of patch cords and can be run but not used for final acceptance criteria.

#### **b.Fiber Testing**

---

1. All installed fiber shall be tested for link-loss in accordance with ANSI/TIA-C.0 and shall be within limits specified within ANSI/TIA-C.3, or as spelled out in the project documentation.
2. For horizontal cabling system using multimode optical fiber, attenuation shall be measured in one direction at either 850 nanometer (nm) or 1300 nm using an LED light source and power meter.
3. Attenuation testing shall be performed with a stable launch condition using two-meter jumpers to attach the test equipment to the cable plant. The light source shall be left in place after calibration and the power meter moved to the far end to take measurements.
4. Backbone single-mode fiber cabling shall be tested at the 1310 and 1550 wavelengths in both directions.
5. Test set-up and performance shall be conducted in accordance with ANSI/568-C.0 standard, Method B.
6. Where links are combined to complete a circuit between devices, the Contractor shall test each link from end to end to ensure the performance of the system. Only basic link-loss testing with a power meter is required. The contractor can optionally install patch cords to complete the circuit and then test the entire channel. The test method shall be the same used for the test described above.
7. The values for calculating loss shall be those defined in the ANSI/TIA 568-C.3 Standard. If the link loss requirements defined within the standard are in conflict with those referenced in the project documentation, Contractor shall immediately bring this to the attention of Information Technologies for resolution.

#### **c.System Documentation**

---

1. Upon completion of the installation, the telecommunications contractor shall provide three (3) full documentation sets to Canyons Schools for approval. Documentation shall include the items detailed in the sub-sections below.
2. Documentation shall be submitted within ten (10) working days of the completion of each testing phase. This is inclusive of all test results and draft as-built drawings. Draft drawings may include annotations done by hand. Machine generated (final) copies of all drawings shall be submitted within 30 working days of the completion of each testing phase.
3. Contractor shall submit with drawings a diagram of each telecommunications room with indicating which cabling drops will terminate in which rooms (classrooms). This is both to give an idea of contractor cable plant design, as well as to facilitate future troubleshooting.



4. At the request of the Information Technologies Engineer, the telecommunications contractor shall provide copies of the original test results in tester native format, not spreadsheet.
5. Information Technologies may request that a 10% random field re-test be conducted on the cable system, at no additional cost, to verify documented findings. Tests shall be a repeat of those defined above. If findings contradict the documentation submitted by the telecommunications contractor, additional testing can be requested to the extent determined necessary by Information Technologies, including a 100% re-test. This re-test shall be at no additional cost to the Canyons School District Information Technologies.

#### **d. Test Results**

---

1. Documentation shall be provided in electronic format within three weeks after the completion of the project. The media shall be clearly marked on the outside front cover with the words "Project Test Documentation", the project name, and the date of completion (month and year).
2. The results shall include a record of test frequencies, cable type, conductor pair and cable (or outlet) I.D., measurement direction, reference setup, and crewmember name(s). Documentation shall also include test equipment name, manufacturer, model number, serial number, software version and last factory calibration date.
3. Unless the manufacturer specifies a more frequent calibration cycle, an annual calibration cycle is anticipated on all test equipment used for this installation.
4. The test document shall detail the test method used and the specific settings of the equipment during the test as well as the software version being used in the field test equipment.
5. Printouts generated for each cable by the wire (or fiber) test instrument shall be submitted as part of the documentation package. Alternately, the telecommunications contractor may furnish this information in electronic form.
6. The media shall contain the electronic equivalent of the test results as defined by the specification along with the software necessary to view and evaluate the test reports.
7. When repairs and re-tests are performed, the problem found and corrective action taken shall be noted, and both the failed and passed test data shall be documented.
8. The As-Built drawings are to include cable routes and outlet locations. Their sequential number as defined elsewhere in this document shall identify outlet locations.



- 
9. Numbering, icons, and drawing conventions used shall be consistent throughout all documentation provided. The School District will provide floor plans in paper and electronic (DWG, AutoCAD) formats on which as-built construction information can be added.
  10. These documents will be modified accordingly by the Telecommunications Contractor to denote as-built information as defined above and returned to the Canyons School District.
  11. The Contractors shall annotate the base drawings and return a hard copy (same plot size as originals) and electronic (AutoCAD) form.

END OF SUB-SECTION V



## Appendix A – Materials List

Manufacturer	Part Number	Description
<b>COPPER DISTRIBUTION</b>		
General Cable	<b>7141819</b>	CAT6A GenSPEED® 10 UTP plenum (CMP), 4-pair, UTP copper cable, 0.25 OD – blue
General Cable	<b>2131752E</b>	25 pair, plenum rated, Category 5E cable – gray.
General Cable	<b>8136100</b>	CAT6A GenSPEED® Outside Plant Cable
Panduit	<b>CJ6X88TGBL</b>	Category 6A, RJ45, 8-position, 8-wire, 10 Gb/s UTP Mini-Com® universal jack module has TG-style termination – color black. For other standard colors, replace suffix “BL” with IW (Off White) with EI (Electric Ivory), WH (White), AW (Arctic White), IG (International Gray), OR (Orange), RD (Red), BU (Blue), GR (Green), YL (Yellow), or VL (Violet). Canyons School District standardize on black unless otherwise indicated in project documentation. NOTE MODULAR PATCH PANELS MUST BE POPULATED WITH JACKS AS WELL AS STAINLESS FACEPLATES.
Panduit	<b>CMBBL-X</b>	Mini-Com blank module to blank out open spaces (holes) on faceplates and patch panels. For colors other than black replace “BL” with IW (Off White) with EI (Electric Ivory), WH (White), or IG (International Gray).
Panduit	<b>CPPL24WBLY</b>	24-port patch panel with labels, supplied with six factory installed CFFPL4 type front removable snap-in faceplates. Contractor to populate black Cat 6 jacks as specified in this document.
Panduit	<b>CPPL48WBLY</b>	48-port patch panel with labels, supplied with six factory installed CFFPL4 type front removable snap-in faceplates. Contractor to populate with black Cat 6 jacks as specified in this document.
Panduit	<b>UTP28X**BU</b>	Category 6A Performance, 28AWG, UTP patch cord. For lengths 1 to 50 feet (increments of one foot), replace ** with desired length in feet. For standard cable colors other than Off White, replace “BU” with color code: BL (Black), RD (Red), YL (Yellow), GR (Green), OR (Orange), GY (Gray), PK (Pink), or VL (Violet).
Panduit	<b>CFPSL4IWY</b>	Single gang, plastic, sloped vertical faceplate accepts four Mini-Com® Modules.
Panduit	<b>CFPSL6IWY</b>	Double gang, plastic, sloped vertical faceplate accepts eight Mini-Com® Modules. For labels use
Panduit	<b>UICFPSE8IW-2G</b>	Double-gang, plastic, sloped vertical faceplate holds up to eight Mini-Com® Modules.
Panduit	<b>CFPL4SY</b>	Single gang, stainless steel vertical faceplate accepts four Mini-Com® Modules. Requires minimum 1.9" wide electrical box for proper mounting.
Panduit	<b>CFPL8S-2GY</b>	Double gang, stainless steel vertical faceplate accepts eight Mini-Com® Modules.
Panduit	<b>P110KB1005Y</b>	Panduit Pan-Punch 100 pair 110 block termination kits for 25pr 5E cable. Field terminated. Includes a base, 5-pair connector kit with five 5-pair connectors per row of 25 pairs, two label holders, and two white designation labels.
<b>FIBER DISTRIBUTION SYSTEMS</b>		
General Cable	<b>BE0121ANU-ILPA</b>	Plenum-rated, indoor/outdoor tight-buffered, armored OM3 12 strand fiber cable.
General Cable	<b>BE0241ANU-ILPA</b>	Plenum-rated, indoor/outdoor tight-buffered, armored OM3 24 strand fiber cable.
General Cable	<b>BL0121ANU-ILPA</b>	Plenum-rated, indoor/outdoor tight-buffered, armored OM4 12 strand fiber cable. (Use OM4 for any telecom rooms that are further than 300M apart).
General Cable	<b>BL0241ANU-ILPA</b>	Plenum-rated, indoor/outdoor tight-buffered, armored OM4 12 strand fiber cable. (Use OM4 for any telecom rooms that are further than 300M apart).
Panduit	<b>FLCDMCXAQY</b>	LC OptiCam® 10Gig™ 50/125µm Multimode Duplex Fiber Optic Connector for 900µm tight-buffered fiber installation.
Panduit	<b>FCE1U</b>	Opticom® QuickNet™ Rack Mount Fiber Enclosures, holds up to four QuickNet™ Cassettes, FAP adapter panels, or FOSM splice modules. Dimensions: 1.73"H x 17.60"W x 16.30"D (43.9mm x 447.0mm x 414.0mm).



INFORMATION TECHNOLOGIES  
8/31/2018

Panduit	<b>FCE2U</b>	Opticom® QuickNet™ Rack Mount Fiber Enclosures, holds up to eight QuickNet™ Cassettes, FAP adapter panels, or FOSM splice modules. Dimensions: 3.48"H x 17.60"W x 16.30"D (88.4mm x 447.0mm x 414.0mm).
Panduit	<b>FAP6WAQDLC</b>	LC 10Gig™ FAP loaded with six LC 10Gig™ Duplex Multimode Fiber Optic Adapters (Aqua) with phosphor bronze split sleeves.
Panduit	<b>FAPB</b>	Blank fiber adapter panel – reserves space for future use.
Panduit	<b>FX2ERQNSNM***</b>	OM4 push/pull LC jumper/patch cord. Riser rated. *** At end of part number is for length in meters. Comes in 1 M increments up to 20 meters, then in lengths of 20 M, 25 M, 30 M, and 35 M. Put length in the following (3 digit) format: 001 for 1 M, 020 for 20 M, etc.
		<b>RACKS AND CABLE MANAGERS</b>
Panduit	<b>R4P</b>	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 30.0"D (2134mm x 591mm x 762mm).
Panduit	<b>R4P36</b>	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 36.0"D (2134mm x 591mm x 914mm).
Panduit	<b>R4P42</b>	4 post EIA rack with #12-24 threaded rails. Dimensions: 84.0"H x 23.25"W x 41.5"D (2134mm x 591mm x 1054mm). FOR TOP OF RACK INTERBAY ROUTING.
Panduit	<b>R4PWF</b>	Top trough with waterfall for 4-post racks creates pathway above rack. Dimensions: 1.9"H x 26.1"W x 8.5"D (50mm x 662mm x 216mm).
Panduit	<b>R2P</b>	19" EIA 2-post rack, aluminum. Dimensions: 84.0"H x 20.3"W x 3.0"D (2134mm x 514mm x 76mm).
Panduit	<b>R2PPEVWF</b>	Waterfall Trough for 2 Post Rack and PatchRunner high capacity – Vertical Cable Managers. FOR TOP-OF-RACK INTERBAY ROUTING.
Panduit	<b>PEV6</b>	High capacity dual-sided vertical manager. Dimensions: 83.5"H x 6.0"W x 28.1"D (2120mm x 152mm x 714mm).
Panduit	<b>PED6</b>	Dual hinged metal door. Dimensions: 82.8"H x 6.1"W x 1.7"D (2103mm x 155mm x 43mm).
Panduit	<b>PEV8</b>	High capacity dual-sided vertical manager. Dimensions: 83.5"H x 8.0"W x 28.1"D (2120mm x 203mm x 714mm).
Panduit	<b>PED8</b>	Dual hinged metal door. Dimensions: 82.8"H x 8.1"W x 1.7"D (2103mm x 206mm x 43mm).
Panduit	<b>PEV10</b>	High capacity dual-sided vertical manager. Dimensions: 83.5"H x 10.0"W x 28.1"D (2120mm x 254mm x 714mm).
Panduit	<b>PED10</b>	Dual hinged metal door. Dimensions: 82.8"H x 10.1"W x 1.7"D (2103mm x 256mm x 43mm).
Panduit	<b>NM1</b>	Horizontal Cable Manager High Capacity Front and Rear 1 Rack Unit. 1.7"H x 19.0"W x 13.1"D (44mm x 482mm x 332mm).
Panduit	<b>NMF1</b>	Horizontal Cable Manager High Capacity Front Only 1 Rack Unit. 1.7"H x 19.0"W x 6.2"D (44mm x 482mm x 157mm).
Panduit	<b>NM2</b>	Horizontal Cable Manager High Capacity Front and Rear 2 Rack Units. 3.5"H x 19.0"W x 13.1"D (88mm x 482mm x 332mm).
Panduit	<b>NMF2</b>	Horizontal Cable Manager High Capacity Front Only 2 Rack Units. 3.5"H x 19.0"W x 6.2"D (88mm x 482mm x 157mm). FOR MID-RACK INTERBAY ROUTING.
Panduit	<b>NMF3</b>	Horizontal Cable Manager High Capacity Front Only 3 Rack Units. 5.2"H x 19.0"W x 6.2"D (133mm x 482mm x 157mm). FOR MID-RACK INTERBAY ROUTING.
Panduit	<b>CMUT19</b>	2 RU upper trough with 1.3" bend radius mounts to the top of a standard 19" EIA rack. Dimensions: 3.5"H x 19.0"W x 4.5"D (89mm x 483mm x 114mm). FOR BOTTOM-OF-RACK INTERBAY PATHWAY.
Panduit	<b>CMLT19</b>	4 RU lower trough with 1.3" bend radius mounts to the bottom of a standard 19" EIA rack. Dimensions: 8.0"H x 19.0"W x 4.5"D (203mm x 483mm x 114mm). FOR BOTTOM-OF-RACK INTERBAY PATHWAY. LARGER OPTION THAN CMUT19 IF NEEDED.
		<b>CABLE PATHWAYS</b>
Panduit	<b>J-Pro J-Hook system</b>	Panduit J-Pro System. Plenum rated composite J-hooks with hardware available for various hardware applications.
B-line	<b>WB400</b>	B-line basket tray.





INFORMATION TECHNOLOGIES  
8/31/2018

Panduit	<b>LD10IW10-A</b>	LD10 International White Plastic Raceway, see catalog or <a href="http://www.panduit.com">www.panduit.com</a> for fittings. For 8' sections order LD10IW18-A.
Panduit	<b>LD2P10</b>	Dual Power/Data Raceway channel plastic raceway for concurrently running power and data. See catalog or <a href="http://www.panduit.com">www.panduit.com</a> for fittings.
Panduit	<b>JBX3510IW-A</b>	Single gang two-piece snap together outlet box with adhesive backing. Box accepts Pan-Way® Screw-On Faceplates or any NEMA standard single gang faceplate. For use with Pan-Way® T45 or LD profile raceway. 5.00"L x 3.26"W x 1.62"H (127.1mm x 82.7mm x 41.1mm). Breakouts for 1/2", 3/4", or 1" diameter conduit.
Panduit	<b>JBP2IW</b>	Double gang two-piece screw together outlet box. Box accepts Pan-Way® Screw-On Faceplates or any NEMA standard double gang faceplates. For use with Pan-Way® LD profile raceway. 5.05"L x 5.05"W x 1.62"H (128.2mm x 128.2mm x 41.1mm). Breakouts for 1/2" or 3/4" diameter conduit.
Panduit	<b>T70BIW10</b>	Panduit T-70 dual channel plastic raceway for concurrently running power and data in computer labs. See catalog or <a href="http://www.panduit.com">www.panduit.com</a> for partitions and fittings. For 8 foot sections replace "10" in part number with "8".
Panduit	<b>T70CIW10</b>	Cover for T-70 dual channel raceway. For 8 foot sections replace "10" in part number with "8".
		<b>BONDING AND GROUNDING</b>
Panduit	<b>ACG24K</b>	#6 AWG (16mm <sup>2</sup> ) jumper for armored cable diameter up to 0.84" (21.3mm); 24" (609.6mm) length; factory terminated on one end with LCC6 two-hole copper compression lug and the other end with grounding terminal; provided with two each #12-24 and M6 thread-forming screws and a black polypropylene terminal cover.
Panduit	<b>LCC series</b>	Panduit two-hole compressing lugs for code conductors in BICSI hole spacing.
Panduit	<b>HTCT series</b>	Panduit HTAPs. Must be selected according AWG size of run and tap conductors.
Panduit	<b>CLRCVR series</b>	Panduit clear covers for HTAPs. Must be selected according to HTAP being covered.
Panduit	<b>RGS134-1Y</b>	Grounding strip (vertical busbar) for newly installed racks or cabinets with screw rails. 78.65" (2m) length; .67" (17mm) width; .05" (1.27mm) thickness; provided with .16 oz. (5cc) of antioxidant, one grounding sticker and three each #12-24 x 1/2" and M6 x 12mm thread-forming screws.
Panduit	<b>RGCBNJ660P22</b>	Jumper kit for bonding individual racks or cabinets into grounding backbone. #6 AWG (16mm <sup>2</sup> ) jumper; 60" (1.52m) length; 45° bent lug on grounding strip side; provided with .16 oz. (5cc) of antioxidant, two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread forming screws and a copper compression HTAP* for connecting to a #6 to #2 awg sized bonding backbone.
Panduit	<b>GJ672UH</b>	Rack jumper (and cabinet) kits for smaller TR (5 bays or less) to bond individual rack or cabinet directly back to wall mounted busbar. One 72" length #6 AWG green wire with yellow horizontal stripe. Jumper is pre-terminated on one end with LCC6-14JAWH-L and the other end with LCC6-14JAW-L. This rack grounding jumper is 72" long. For other lengths replace the "72" in the part number. Available lengths are 72, 96, 120, 144, 168, 192, 216, 240, 264 and 288 inches.
Panduit	<b>RGESD2-1</b>	Two-hole ESD port with 5/8" hole spacing; provided with an ESD protection sticker, .16 oz. (5cc) of antioxidant, and two each #12-24 x 1/2" and M6 x 12mm thread-forming screws. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH WRIST STRAP RGESDWS.
Panduit	<b>RGESDWS</b>	Adjustable fabric ESD wrist strap with 6' coil cord, banana plug, 1 megaohm resistor and 4mm snap. LOCATE ONE WITHIN REACH OF ALL EQUIPMENT. WORKS WITH ESD PORT RGESD2-1.
Panduit	<b>RGTBSG-C</b>	Green thread-forming bonding screws for use to mount equipment that does not have a built-in grounding pad (terminal).
Panduit	<b>RGEJ1024PHY</b>	24" long pre-terminated equipment grounding jumper #10 AWG (6mm <sup>2</sup> ) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).
Panduit	<b>RGEJ1036PFY</b>	36" long pre-terminated equipment grounding jumper #10 AWG (6mm <sup>2</sup> ) jumper; bent lug on grounding strip side to straight lug on equipment; provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2", M6 x 12mm, #10-32 x 1/2" and M5 x 12mm thread-forming screws. FOR EQUIPMENT LIKE CHASSIS SWITCHES WITH BUILT-IN GROUNDING PAD (TERMINAL).



INFORMATION TECHNOLOGIES  
8/31/2018

Panduit	<b>GB2B0306TPI-1</b>	Wall mounted telecommunications busbar suitable for small telecom room. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 2" x 12" in size.
Panduit	<b>GB2B0514TPI-1</b>	Wall mounted telecommunications busbar suitable for med telecom room. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 2" x 24" in size.
Panduit	<b>GB4B0624TPI-1</b>	Wall mounted telecommunications busbar suitable for main grounding busbar in medium sized facility. Pre-assembled with BICSI/TIA-607-B hole spacing. Bar is 1/4" x 4" x 20" in size.
Panduit	<b>LTYK</b>	Wall mounted busbar label kit. Label kit includes printed tag and one flame retardant cable tie.
		<b>NETWORK LABELING SOFTWARE – FOR INK JET/LASER PRINTER</b>
Panduit	<b>PROG-EM2GO</b>	Easy-Mark Labeling Software for PC, supplied on USB Flash Drive. For preprinting communications labels on laser/inkjet printer.
Panduit	<b>S100X150YAJ</b>	Self-laminating cable labels for Category 6 cable for use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>C261X035Y1J</b>	Patch Panel labels for use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>C195X040Y1J</b>	Faceplate labels for single gang stainless or sloped plastic - use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>C288X040Y1J</b>	Faceplate labels for double gang stainless - use with Easy-Mark software and laser/ink jet printer.
Panduit	<b>S100X650YAJ</b>	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with Easy-Mark software and ink jet printer.
Panduit	<b>S100X160YAJ and NWSLC-3Y</b>	Label and turn-tell sleeve for labeling fiber jumpers. For use with Easy-Mark software and ink jet printer.
Panduit	<b>C200X100FJJ</b>	1" high, white, vinyl tape labels for labeling grounding busbars, racks, cabinets and pathways. For use with laser/ink jet printer.
		<b>NETWORK LABELING – HANDHELD LABELER</b>
Panduit	<b>LS8EQ-KIT-ACS</b>	Panduit PanTher hand-held label printing system in kit. Includes LS8EQ printer with QWERTY keypad, one cassette of S100X150VAC self-laminating labels, six AA alkaline batteries, LS8E-ACS, LS8-CASE, LS8-PCKIT, LS8-IB, LS8-WS, quick reference card and operator's manual. USE FOR LABELS THAT MUST BE PRINTED ON THE JOB SITE.
Panduit	<b>S100X150VAC</b>	Self-laminating cable labels for Category 6 cable for use with PanTher LS8E hand-held printer.
Panduit	<b>C261X035Y1C</b>	Handheld printer labels for modular faceplate patch panels.
Panduit	<b>C195X040Y1C</b>	Faceplate labels for single gang stainless - use with PanTher handheld labeler.
Panduit	<b>C288X040Y1C</b>	Faceplate labels for double gang stainless - use with PanTher handheld labeler.
Panduit	<b>S100X650VAC</b>	Cable label for indoor/outdoor tight-buffered armored fiber optic cable. For use with handheld labeler.
Panduit	<b>S100X160VAC and NWSLC-3Y</b>	Label and turn-tell sleeve for labeling fiber jumpers. For use with hand-held labeler.
Panduit	<b>T100X000VPC-BK</b>	1" high, continuous black on white, vinyl tape labels for labeling racks, cabinets and pathways with PanTher LS8E handheld labeler.
		<b>PHYSICAL SECURITY LOCKING DEVICES</b>
Panduit	<b>PSL-DCJB-C</b>	Package of 100 RJ45 jack blockout devices and one removal tool. Color red.
Panduit	<b>PSL-USBA-L</b>	Package of 50 USB Type 'A' blockout devices and one removal tool. Color red.
Panduit	<b>PSL-USBB-L</b>	Package of 50 USB Type 'B' blockout devices and one removal tool. Color red.
Panduit	<b>PSL-DCPLX-BL-C</b>	Package of 100 RJ45 plug lock-in devices compatible with flush mount jacks, and one installation/removal tool. Color black.





---

Panduit	<b>PSL-DCPLRX-BL-C</b>	Package of 100 RJ45 plug lock-in devices compatible with recessed jacks, and one installation/removal tool. Color black.
		<b>CABLE TIES – HOOK AND LOOP</b>
Panduit	<b>TTS-35RX0</b>	.75" wide, continuous roll Hook and Loop Cable Ties, black. 35 ft roll. Carton qty 10 rolls.
Panduit	<b>HLSP1.5S-X12</b>	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.
Panduit	<b>HLSP3S-X12</b>	Plenum rated hook and loop cable ties for air return spaces. Maroon color, perforated at 6" length.

<END OF APPENDIX A>

**BLANK PAGE**

INTENTIONALLY LEFT BLANK

## SECTION 27 4100 - AUDIOVISUAL SYSTEMS

### PART 1 – GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.
- C. Refer to specification 26 0553 for conduit and junction box color requirements.
  - 1. Category cables used for transporting video, audio and controls simultaneously from transmitters to receivers and/or switchers shall follow the Manufacturer's recommend cabling specifications.

#### 1.2 ADMINISTRATIVE REQUIREMENTS:

- A. BNA Project Contact:
  - 1. Eric Mangum, CTS-D
    - a. Phone: 801-532-2196
    - b. Email: [emangum@bnaconsulting.com](mailto:emangum@bnaconsulting.com)
  - 2. Jaime Verhaal, CTS-D, RCDD
    - a. Phone: 801-532-2196
    - b. Email: [jverhaal@bnaconsulting.com](mailto:jverhaal@bnaconsulting.com)
- B. Bid Submittal:
  - 1. Equipment Costs: Breakout cost of material and labor as different line items.
- C. Coordination:
  - 1. Coordinate final inspection of the systems installed, with Audiovisual (AV) Consultant, three (3) weeks in advance.
  - 2. Obtain GANTT chart for construction time frame from the General Contractor.
  - 3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted AV equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted AV equipment in each area.
  - 4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.
  - 5. Meet with Electrical contractor prior to pathway rough-in to coordinate AV system requirements in each area.
  - 6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all AV network requirements. Coordinate cable color according to specification 26 0553.

7. Meet at least twice with owner and programmer to coordinate AV network requirements. Hold the first meeting after submittal of shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to AV system deployment.
  8. Coordinate color and finish of all AV system components with Architect or Electrical contractor as appropriate.
  9. Coordinate all AV system components within millwork/furniture with millwork shop drawings prior to rough-in.
  10. Notify AV Consultant when rough-in is complete and ready to inspect. AV Consultant and Electrical Engineer to sign off on rough-in prior to rough-in resuming rough-in for typical rooms.
- D. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.

1.3 DESCRIPTION OF WORK:

- A. Provide the specified systems in a complete and operating condition with all necessary materials and labor to fulfill the requirements and the intent of the drawings and specifications. Except as otherwise indicated, provide manufacturer's standard system components. Contractor shall furnish all cables, materials and equipment, whether specifically mentioned herein or not, to ensure a complete and functional system.
- B. Master quotes do not relieve contractor from performing due diligence for equipment type, equipment quantity, and quantity of room types. Any errors, conflicts, or omissions between the drawings and/or specifications and master quotes shall be the responsibility of the contractor to resolve.
- C. Bidders wishing to provide equipment other than the equipment specified shall submit proposed substitute equipment to AV Consultant eight (8) working days prior to bidding. Submittals for prior approval shall include description of equipment, design intent, complete riser diagrams for proposed equipment, equipment specifications, cut sheets of proposed equipment, reason for alternate equipment. AV Consultant may request physical equipment to test and demo. Acceptance of proposed equipment by AV Consultant shall not relieve AV contractor from responsibility to provide audio-visual systems equal to those specified in this Section. Contractor shall be ultimately responsible for providing complete and working audio-visual systems that function, control and operate in the same manner as the specified equipment. AV Consultant has final say if proposed equipment is equal to the specified equipment. Equipment that AV Consultant is not familiar with will require the contractor to provide manufacturer training at manufacturer's facility and have a manufacturer representative present at time of commissioning.
  1. Refer to section 2.2 for approved equals of basis of design equipment.
- D. Equipment submitted in the bid proposal that has not been approved by AV Consultant in writing will not be accepted and shall be replaced by approved equipment at contractors' expense. Equipment not listed within this specification, or contract documents, that is required for a complete and working system, shall be of professional grade, new and used in the same manner as needed for a complete and working system.
- E. Input plates shall match the color and style being used throughout the project.

- F. All control processors, controllers, DSPs, and Network Switches are to be on an unswitched power connection and connected to an uninterrupted power supply.

#### 1.4 DEFINITION OF TERMS:

- A. Approve: The term "approved," where used in conjunction with the Engineer's action on the Contractor's applications and requests, is limited to the Engineer's duties and responsibilities as stated in General and Supplementary Conditions.
- B. Configure: The term "Configures" or "Configuration" is used to describe set up of components which includes menu based settings, image alignment, dip switches, setup wizards, EDID, etc. required for standard functionality.
- C. Contractor: the term "Contractor" refers to the company contracted to perform the work within this specification and associated documents.
- D. Directed: Terms such as "directed," "requested," "authorized," "selected," "approved," "required," and "permitted" mean "directed by the Engineer," "requested by the Engineer," and similar phrases.
- E. Furnish, Install, and Provide: Refer to 26 0500 for definition.
- F. General: Basic Contract definitions are included in the General Conditions.
- G. Graphical User Interface (GUI): The term "Graphical User Interface (GUI)" is used to describe the user interface from a touch screen. This is a custom interface provided with the programming of the system.
- H. Indicated: The term "indicated" refers to graphic representations, notes, or schedules on the Drawings, other paragraphs or schedules in the Specifications, and similar requirements in the Contract Documents. Where terms such as "shown," "noted," "scheduled," and "specified" are used, it is to help the reader locate the reference; no limitation on location is intended.
- I. Installer: An "Installer" is the Contractor, or an entity engaged by the Contractor, either as an employee, subcontractor, or sub-subcontractor, for performance of a particular construction activity, including installation, erection, application, and similar operations. Installers are required to be experienced in the operations they are engaged to perform.
- J. Programming: The term "Programming" is used to describe writing computer code or a sequence of logic to perform an operation from a triggering event. Programming will be installed on a control processor or similar platform identified within the documents.
- K. Programmer: the term "Programmer" is the company or entity engaged by the programming company, either as an employee, subcontractor, or sub-subcontractor, for providing the programming services.
- L. Regulation: The term "Regulations" includes laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, as well as rules, conventions, and agreements within the construction industry that control performance of the Work.
- M. Substitutions: Requests for changes in products, materials, equipment, and methods of construction required by Contract Documents proposed by the Contractor after award of the Contract are considered requests for "substitutions."

1.5 QUALITY ASSURANCE:

A. Installer:

1. Integrating firm shall have worked satisfactorily for a minimum of five (5) years of completing systems equal to this scope, quality, type and complexity.
2. Key personnel assigned to the project shall each have minimum of ten (10) years of experience in completing systems equal to this scope, quality, type and complexity.
3. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
4. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
5. Contractor shall have current manufacturer certificates for all AV systems and equipment listed within this specification.
6. Contractor shall be in good standing with the owner.
7. Contractors that do not meet the above requirements cannot bid on this project.

B. Contractor must follow the standards described within:

1. BICSI/AVIXA AV Design Reference manual.
2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.

C. All work shall be done by expert technicians qualified in the field with knowledge of specified systems. Workmanship shall comply with industry best practices concerning grounding, shielding, cable dressing, cable termination and equipment mounting.

D. PRE-APPROVED INSTALLERS:

1. AVI-SPL
2. Absolute AV
3. Cache Valley Electric
4. Ford AV
5. GenComm
6. Hunt Electric
7. LINX
8. Performance Audio
9. Poll Sound
10. Summit Fire
11. TPI
12. TVS Pro
13. Wasatch Electric
14. WEBB AV

15. Absolute AV
  16. Bids submitted by non-approved installers will not be accepted.
  17. Bidders not pre-approved shall submit in writing the following for review at least eight (8) working days prior to bid:
    - a. List of qualifications including:
      - i. Industries certifications including manufacturers.
      - ii. Approved resale manufacturers.
    - b. Past and current projects within the last five (5) years similar in scope and size.
    - c. Three (3) Different referrals from the owners of three (3) different projects within the last five (5) years.
- 1.6 SUBMITTALS: Refer to specification 26 0502 for shop drawing submittal requirements.
- 1.7 WARRANTY:
- A. Systems shall be guaranteed for a period of one (1) year from the date of substantial completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor, etc. required to maintain the functionality at the time of system completion.
    1. System completion shall be signed off by the programmer, contractor, and the owner. At that time the system will be considered complete.
  - B. If system failure causes the audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair the system to be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.
  - C. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.

## PART 2 – PRODUCTS

### 2.1 GENERAL:

- A. All equipment shall be installed as shown on the drawings and in strict accordance with the specifications. Any errors, conflicts, or omissions discovered in the specifications or the drawings shall be submitted in writing to the AV Consultant for clarification.
- B. Equipment lists are provided to identify quality and functional expectations. They may not be complete. Coordinate with devices shown on drawings, system risers and equipment lists for system intent. Provide a complete and functional system as described within the construction documents.

### 2.2 MANUFACTURER APPROVED EQUALS:

- A. The Manufacturers listed below have the potential to be considered equals, as it relates to the system design intent and the equipment specified herein. Refer to section 1.3.C. for substitution requirements. Any equipment chosen as equal to what has been specified in section 2.4 will be the responsibility of the AV Integrator to coordinate all resulting

changes and guarantee a complete and functional system e.g. rough-in requirements, programming, etc. Please note that some components have been chosen over others for features and/or size limitations. Equipment listed below with an asterisk have feature and/or size limitations and may not be substituted.

1. Amplifiers – Ashly, Crestron, Crown, Extron, Lab Gruppen, LEA Professional, Powersoft, QSC
2. Assisted Listening Systems – Listen Technologies, Williams AV
3. Cables – Belden, Crestron, Extron, Gepco/General, Ice, Kramer, Liberty, and Westpenn cables
4. Controls – AMX, Crestron and Extron
5. Displays – LG, NEC, Planar, Panasonic, Samsung, Sharp, and Sony
6. DSPs – Biamp, Extron, QSC and Symetrix
7. Equipment racks – AtlasIED, Chief, Lowell and Middle Atlantic
8. Loudspeakers – AtlasIED, Bose, Community, JBL and SoundTube
9. Microphones – AKG, Audio Technica, Audix, Lectrosonics, Sennheiser and Shure
10. Mounts – Chief and Premier mounts
11. Network equipment – Cisco, Luxell, and Netgear
12. Networked Audio – Attero tech (QSC), Extron, and RDL
13. Projection Screens – Da-Lite, Draper and Stewart Filmscreen
14. Video Equipment – AMX, Crestron, and Extron
15. Wall plates – Attero tech (QSC), Crestron, Extron, RCI Custom, Liberty Panelcrafters and RDL

## 2.3 GENERAL EQUIPMENT REQUIREMENTS:

- A. The equipment specified in this document aims to fulfill the intended functional requirements by precisely identifying the necessary equipment. Depending on the timing of component orders and the project timeline, there may be instances where certain equipment needs to be replaced with newer models. In the event that the indicated equipment is unavailable or has been replaced, the supplier or contractor shall provide a new model that offers comparable functionality.
- B. Loudspeakers:
  1. Provide applicable mounting equipment as needed, including but not limited to; back boxes, mounting hardware, safety equipment, and seismic restraints.
- C. Video Signal:
  1. The equipment listed below is considered to be equal replacement parts for a point-to-point video solution as it relates to the system design intent. Equipment listed in section 2.4 override the equipment listed below.
    - a. Cable Equalizer for cable lengths exceeding 30' but no more than 75' or that have more than two (2) union connections. Connect to external power supply and do not use the 5 volts within the HDMI cable.
      - i. Extron – HD 4K 101 Plus or Kramer – PT-3H2



- b. Point to point HDBaseT extension, 18 Gbps, 4k60 4:4:4 at 100 Meters:
        - i. Crestron – DM-TX-4KZ-100-C-1G with DM-RMC-4KZ-100-C. or Extron – DTP2 T 211 with DTP2 R 211.
    - 2. HDMI cables intended for client device connection and that are less than 15' shall be a flexible cable and support 18 Gbps, 4k60 4:4:4 for the entire length of the cable.
    - 3. Equipment that is not preapproved by the AV Consultant in writing will not be accepted and will be replaced with the approved equipment at no cost to the Owner.
  - D. Audio Signal:
    - 1. The equipment listed below is considered to be equal replacement parts for a point-to-point video solution as it relates to the system design intent. Equipment listed in section 2.4 override the equipment listed below.
      - a. Passive or Active audio summing adapter. Extron – ASA 131 or RDL – STA-1
      - b. Isolation transformer: RDL – EZ-HK1
  - E. Cables grouped together shall be dressed in expandable nylon loom, similar to Techflex - Flexo
  - F. Equipment Racks:
    - 1. All AV equipment racks within this specification shall have the following accessories and/or features, either rack mountable or built into the rack, depending on the model of the rack. Refer to bid documents for all rack mounted equipment. Provide the following accessories as referred to in elevations. RUs are indicated in the elevations and noted with a # symbol in the part number.
    - 2. General Equipment
      - a. Shelving: Middle Atlantic – SS; 1RU shelf.
      - b. Drawers:
        - i. Nonlocking: Middle Atlantic – D#
        - ii. Locking: Middle Atlantic – D#LK
      - c. Header panel, located at the top of the rack, AV contractor to submit their logo to RCI for inclusion in the Header panel. If AV contractor has another company that makes the Header panel, provide that information to the AV Consultant.
        - i. RCI Custom – BNA001-200120MM-01
      - d. Blank plates: Middle Atlantic – EB#
      - e. Surge protection for all devices located within the rack. Surge protector shall be: 20 AMPs, rack mountable or mount to a side rail and at least 1,000 joules of protection.
        - i. Recommended Surge protector is Middle Atlantic – PD-920R-SP. Additional acceptable manufacturers are: Furman, Juice Goose, Tripplite and SurgeX.
      - f. Horizontal, vertical, and entry cable management.

- i. All cabling shall be straight off of the back of equipment to horizontal supports connected to equipment rack. Cabling shall follow support to vertical supports when going into other components and/or out of the equipment rack.
  - ii. Cabling secured to other cabling and supported from the connector is not acceptable.
  - iii. Separate AC power and other signal types from each other.
- g. Provide 20 Amp rated power strips as necessary.
- h. Sequencers:
  - i. Provide a Middle Atlantic – PDS-620R or Furman – CN-2400S Sequencer.
  - ii. All equipment racks with the following equipment shall have a sequencer within the equipment rack. AV integrator to follow industry standards when using sequencers.
    - 1. Amplifiers
    - 2. Video processors without control processors
    - 3. Wireless Mics
- i. Uninterrupted power supply (UPS)
  - i. Provide a Middle Atlantic – UPX-RLNK-1500R-2 UPS.
  - ii. All equipment racks with the following equipment shall have a UPS within the equipment rack.
    - 1. Video Processors
    - 2. DSP
    - 3. Network Switches
    - 4. Control Processors
  - iii. Provide passive thermal management in all racks unless noted above.

## 2.4 EQUIPMENT REQUIRED PER ROOM TYPE

BAND / CHOIR ROOMS EQUIPMENT SCHEDULE			
TY PE	DESCRIPTION	MANFR.	MODEL NO.
R1	EQUIPMENT RACK, WALL MOUNT, 28" TALL, 22" DEEP, 23.5" WIDE, 12RU. NO DOOR	MIDDLE ATLANTIC	EWR-12-22
	SHELF, RACK MOUNT, 10"D, 1 RU	MIDDLE ATLANTIC	UTR1
	BLANK AND VENT PANELS AS REQUIRED	MIDDLE ATLANTIC	BL# SERIES VTP-# SERIES
	BRUSH GROMMET PANEL, 1RU	MIDDLE ATLANTIC	BR1
	POWER CONDITIONER	FURMAN	PL-8C

M2	DUAL MICROPHONE INPUT, WALL PLATE WITH SOLDER CONNECTIONS	RDL	D-XLR2F
HD U	HDMI & AUDIO INPUT, WALL PLATE WITH DTP TRANSMITTER	EXTRON	DTP T HWP 4K 231 D
Rx	VIDEO RECEIVER, DTP	EXTRON	DTP HDMI 4K 230 RX
CS A	CLASSROOM RF MICROPHONE SYSTEM, RF RECEIVER, TEACHER MICROPHONE, NO LOUDSPEAKERS	LIGHTSPEED	975 ACCESS (SKU: 975-F)
MC	MICROPHONE, OVERHEAD, CARDIOD, COLOR BY ARCHITECT	SHURE	MX202
	ULTRA COMPACT 18-IN, 8-OUT DIGITAL MIXER. WIFI, BLUETOOTH, MULTI-TRACK RECORDING. PROVIDE RACK EARS	ALLEN & HEATH	CQ-18T (PROVIDE RACK EARS)
1A	1600W, 2-CHANNEL COMPACT AMPLIFIER w/DSP	POWERSOFT	DUECANALI 1604 DSP
W1	LOUDSPEAKER, CABINET, 90° X 50°, 93 dB, 117 dB MAX, 63 Hz - 19 KHz ±3dB, 8Ω, DRIVERS: 1x8" LF, 1x1.5" MHF COMPRESSION, PWR RATING: 250 LMHF WATTS (COLOR BY ARCHITECT)	JBL	AC18/95
P1	WXGA 3LCD LASER PROJECTOR	EPSON	EB L210W (OFCI)
SC1	WALL MOUNTED, MANUAL, 16X10, 113" SCREEN W/MATTE WHITE MATERIAL	DA-LITE	MODEL C WITH CSR 36441 w/ 6" BRACKET
<b>END OF SCHEDULE</b>			

## PART 3 – EXECUTION

### 3.1 INSTALLATION OF AV SYSTEMS:

- A. Provide AV systems and ancillary equipment as indicated on drawings and in accordance with equipment manufacturer's written instructions, the NEC, and with industry best practices.
- B. Coordinate all work performed by other contractors pertaining to the AV system, including raceways, electrical boxes and fittings.
- C. Video systems.
  1. HDCP:
    - a. All equipment within the signal path must be capable of processing HDCP-compliant material.

- b. All switcher, scalers, transmitters, and receivers shall reflect the HDCP compliance of the endpoint/display(s).
    - c. HDCP shall be disabled in the switcher/scaler when a non-HDCP-compliant endpoint/display is used.
  - 2. EDID Strategy:
    - a. Permanent video sources shall be set manually within the equipment to output their native resolution. Video properties shall not rely on EDID.
    - b. Portable video sources and wall plates shall use EDID tables within the switcher/scaler for preferred video properties. The EDID table shall be set with the following settings:
      - i. Most common resolutions within the display's aspect ratio.
        - 1. 1920 x 1200 (WUXGA) 60Hz
        - 2. 1920 x 1080 (HDTV), 120Hz
      - ii. Audio: refer to control section for audio requirements. This will include mono, Stereo, Surround sound, etc.. All audio will be 44,100 Hz, 16 bit unless otherwise noted.
- D. Pathway Requirements:
  - 1. General:
    - a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.
    - b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Field coordinate alternate pathway requirements with other trades onsite. New pathways shall not exceed distance limitations defined within this specification. Notify the Engineer of the changes for final approval prior to proceeding with the change.
  - 2. Conduits:
    - a. Contractor shall provide a minimum of 1-1" EMT conduit from device to accessible ceiling space unless otherwise noted. Then utilize non-continuous cable support from devices to connecting device. Refer to AV symbol schedule for specific conduit requirements.
      - i. Provide non-continuous open top cable supports every 5' above accessible ceiling.
    - b. Provide conduit from device to device in open and/or exposed ceilings. Ceilings with clouds are considered open/exposed ceiling.
    - c. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
    - d. Provide large radius elbows on all bends.

- e. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.
  - f. AV conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.
  - g. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.
  - h. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.
3. Open Top Cable Support Requirements:
- a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables
  - b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
4. Pull Box Requirements:
- a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.
  - b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.
  - c. Conduits that enter a pull box from opposite ends should be aligned.
  - d. Pull boxes shall have a length 12 times the diameter of the largest conduit.
  - e. All pull boxes must be accessible.
- E. Cabling System:
- 1. Follow T568B scheme for copper category cabling terminations.
  - 2. Provide a minimum 6" service loop in each AV system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.
  - 3. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.
  - 4. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
  - 5. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for AV cable is required, the contractor shall install appropriate carriers to support the cabling.

6. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.
  7. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
  8. Pair untwist at the termination shall not exceed 0.125". The cable jacket shall be maintained as close as possible to the termination point.
  9. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.
  10. Group multiple cabling together with expandable nylon loom, similar to Techflex - Flexo, when cabling exists a cavity and connects to a device. Cabling within a lectern, podium or millwork shall have expandable nylon loom sleeve as well.
- F. Grounding System:
1. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
  2. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
  3. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
  4. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
  5. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.
  6. Refer to electrical diagrams for additional ground connection requirements.
- G. Cabling groups and conduit separation:
1. Refer to "CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE", located on the drawings
- H. Firmly secure all equipment in place that is not intended for portability.
- I. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.
- J. Provide adequate structural support for AV system components. Provide fastenings and supports with a safety load factor of at least five.

### 3.2 LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All AV pathways, cables, connecting hardware, equipment, racks, patch panels, outlet/connectors, and grounding system shall be labeled in accordance with TIA/EIA 606-A.
- C. All labels shall meet UL 969 requirements for legibility, defacement and adhesion requirements. Handwritten, Ink, or Laser Printing labels are not allowed. Labels shall be uniform in physical size and text height with minimal blank space. Provide labels using thermal transfer print. Heat shrinking or wraparound labels are required, flag style labels are not allowed.
- D. Provide laminated plans (minimum size 11x17) of all AV as-built plans (including one-line diagrams) in each and every AV Rack.
- E. Label each equipment with the date (month/year) that it was installed along with the IP address, if applicable, and equipment type.

### 3.3 CYBER SECURITY

- A. Contractor shall change all default username and passwords for all network devices provided. A Strong Password should include at a minimum the following:
  - 1. Be at least 12 characters in length
  - 2. Contain both upper and lowercase alphabetic characters (e.g. A-Z, a-z)
  - 3. Have at least one numerical character (e.g. 0-9)
  - 4. Have at least one special character (e.g. ~!@#\$%^&\*()\_-=)
  - 5. Cannot contain full words
- B. No written username or passwords shall be located in any areas of installation.
- C. Network devices to be set up on a separate network other than owner's LAN ensuring no internal or external users can access system without authorization.
- D. Follow manufacturers hardening guide and use best industry practices to secure network and devices provided by contractor and associated with system.

### 3.4 FIELD QUALITY CONTROL:

- A. TESTING:
  - 1. Refer To Section 27 4101 For Additional Requirements.
- B. At the time of final commissioning, if the AV consultant determines that the systems are not sufficiently complete to do a final punch list, and was not notified at least three (3) days prior to the visit, then a return visit will be required. The AV Consultant's return visit will

be paid for in advance by the AV integrator at a flat rate of \$400 per person, at no cost to the owner.

3.5 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

3.6 TRAINING:

A. Provide one (1) session of two (2) hours each of training on the operation of each system, at job site, at no cost to owner. Systems shall be complete and have been finalized by the AV Consultant prior to training.

1. Band and Choir Rooms

a. Obtain a sign-off from Band and Choir teachers indicating that they have been thoroughly trained, and are satisfied that they understand the system.

B. Training shall be recorded using a video recording device that support a minimum resolution of 1080P/60 with an integrated microphone connection for an external microphone and a camera tri-pod mount. Presenter shall be wearing a lapel microphone that connects to the recording device and a Tri-pod shall be used for stabilizing the recording device. Recordings that are shaky, poor audio and/or video quality, incomplete, or other issues will not be accepted and the contractor will be responsible for providing a new recording and training within five (5) business days of notification. Provide a digital copy, in MP4 format, on a USB flash drive to the Owner and AV Consultant. Also locate a USB flash drive with the training videos, programing, etc. in the as-built drawer of the main equipment rack. Digital copies sent as a link are not acceptable. identify within the Operating and Maintenance manuals, in the first section, where the flash drive is stored. Clearly label the flash drive as training videos.

3.7 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 4100



SECTION 27 4101 - AUDIOVISUAL SYSTEM INTEGRATOR VERIFICATION CHECKLIST

PART 1 – GENERAL

1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-27 4100 section apply to work specified in this section.

1.2 ADMINISTRATIVE REQUIREMENTS:

- A. This Document is intended to be completed and supplied to the AV Consultant prior to the final punch visit. Refer to specification 27 4100 for system components.
- B. Installing contractor shall make copies of this document for large systems. Include all copies in the O & Ms and provide all copies to the AV Consultant.

1.3 DESCRIPTION OF WORK:

- A. Refer to “INTEGRATOR VERIFICATION CHECKLIST” at the end of this section, for system verification requirements. Fill out the form and return to the AV Consultant prior to the final punch.
- B. Upon completion of installation of each system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units on site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.
- C. Before inspection by owner and AV Consultant, and after completion of the installation, conduct system tests and make necessary corrections for proper system operation.
- D. Adjust, balance and align equipment for optimum quality and to meet the manufacturer’s published specifications.
- E. All limiters and/or compressors shall be set to prevent operators from over-adjusting sound levels and damaging system components, while maintaining the highest amount of gain possible.
- F. System shall have no audible hum, noise, RFI, or distortion when operating under normal conditions. System shall reproduce material at the loudspeakers rated output level without audible distortion. All input levels shall be pre-set so system may be operated without causing unstable feedback under normal use.
- G. System shall have no image distortion, hum bars, color shift, or any other picture distortion while operating under normal conditions. Provide cable equalizers or an HDBaseT video solution. Cable equalizer shall be located near display and powered, on all cables that are more than 30 feet in length or with more than four (4) connection points. Refer to section 2.3.B in this specification for a list of pre-approved equipment. Adjust gain controls for optimum signal-to-noise with 0 dBu at a line-level input.
- H. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.

- I. Loose parts and poor workmanship or soldering shall be replaced.
- J. Sweep Loudspeaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to Loudspeakers or enclosures. Notify owner of external causes of buzzes or rattles.
- K. Equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and 8000 Hz (+/- 3 dB).
- L. Contractor shall provide system testing as described herein using up-to-date and industry accepted test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1. AV Contractor shall own and have access to a handheld Quantum Data 780C tester to allow for on-site verification testing and troubleshooting of HDMI and digital video networks and analog video displays. All test equipment used shall be factory calibrated within one year of use with references set daily prior to testing.
- M. Contractor shall provide HDCP compliant device with digital cables, and digital HDCP content for testing of routing and HDCP compliant distribution and switching. Also provide analog VGA output equipment for testing of video switching, scaling, and distribution if analog is included with this project.
- N. Horizontal cabling contractor shall test all twisted pair cabling used within the AV system following the standards in specification 27 1500 under the testing section. Provide documentation of testing to AV Consultant prior to final walk through.

## PART 2 – PRODUCTS

### 2.1 SECTION NOT USED

## PART 3 – EXECUTION

### 3.1 AUDIOVISUAL SYSTEMS INTEGRATOR VERIFICATION CHECKLIST

Project Title		Date	
City, State		Integrator	
Room/Area			

Audio/Video Signal Processors/Switchers					
Location	Rack #	Manufacturer & Model #	Serial #	Total Channels (In, Out)	Unused Channels (In, Out)

Power Amplifiers
------------------

Location	Rack #	Amp #	Manufacturer & Model #	Serial #	Total Channels	Watts/Channel

Loudspeakers Zones							
Location	Rack #	Amp #	Amp Chan	Manufacturer & Model #	Serial #	Calculated Impedance	Measured Impedance

Wireless Microphone Receivers					
Location	Rack #	Manufacturer & Model #	Serial #	Usable Frequency Range	Chosen Frequency

Portable & Miscellaneous Equipment			
Description	Location	Quantity	Manufacturer & Model #.

Sign below to confirm you have received portable & miscellaneous equipment listed above.

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

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

Title: \_\_\_\_\_

Personal Delivering Equipment: \_\_\_\_\_

#### General Items

Title	Description	Initial	Notes
Labeling	Verify that all cabling, equipment, and wall plates are labeled per specifications and as noted on drawings		
Cable management	Verify that proper cable management has been provided and that everything looks well-ordered.		
Power	Verify that power supplies are secured and in an accessible area.		
Sequencer	Verify that the sequencer(s) are setup correctly for industry standard power on/off function.		
Cyber Security	Verify that all default passwords have been changed. Provide all login information to the owner representative		
System testing	Verify that all systems have been tested and are in working order.		
System Certification	Verify system has been tested with industry standard testing equipment		

	including the use of Quantum Data 780C		
Cabling	Verify that all cabling on the project meets the document requirements.		
Network	Verify that the owner has all of the needed information for all devices on the network. Provide this information to the owner via a spread sheet.		
Network	Verify that all IP address are within the owner's network scheme.		
Network	Verify that VLANs are setup as indicated in drawings and within owner's network infrastructure		
System One-lines	Verify that each equipment rack contains a set of one-lines diagrams for system installed. Refer to specifications for one-line requirements.		
Thermal Management	Verify active thermal management is setup correctly and working properly.		
Training	Verify training has been scheduled with the owner representative.		

#### Audio Performance

Title	Description	Initial	Notes
Audio Signal Distribution	Verify that audio signal is being transported and distributed according to project documentation.		
Phantom Power	Verify that the correct phantom power is provided at the correct locations according to project documentation.		
Gain Before Feedback	Verify that the audio system is capable of reproducing speech above nominal operating levels without audible distortion or feedback.		
Rough Balance (input)	Verify that all inputs have the same nominal level.		
Gain Structure	Verify that proper gain structure has been followed from each input to output		
Rough EQ	In systems with equalization capability, equalize the loudspeakers to produce less than 6 dB total variation between 500 Hz and 8000 Hz (+/- 3 dB).		

DSP Programming	Verify that DSP systems have been programmed to allow signal routing, balance, and EQ. DSP programming should be saved in editable form prior to final commissioning visit.		
Rough Balance (output)	Verify that loudspeaker zones reproduce program content at the same level (+/- 1 dB).		
Emergency Muting	Verify that any required muting or operational changes are in accordance with location regulations in the event of a life safety or similar emergency.		
Assistive Listening	Verify that the assistive listening system functions as a complete personal listening system at specified levels without distortion or excessive background noise.		
Loudspeakers	Verify that there is no hum, noise, RFI, or distortion when operating under normal conditions.		
Loudspeakers	Verify that there are no rattles or buzzes with a high-level sign wave or 1/3 octave pink noise.		
Loudspeaker Zoning	Verify that loudspeaker zones are assigned correctly according to project drawings and specifications.		
Loudspeaker Impedance	Verify that all loudspeaker circuits have correct impedance as defined in the project drawings and specifications. Note measured impedance on previous page.		
Loudspeaker Alignment	Verify that loudspeakers are mounted and aligned as shown in project documentation.		
Loudspeaker Polarity	Verify that all loudspeakers in a given space are wired with the same polarity.		
Loudspeaker Tap Settings	Verify the tap settings on all constant voltage loudspeakers.		
Loudspeaker Delays	Verify that loudspeakers are set with the proper delay. Refer to drawings and specifications for requirements		

Control System Performance

Title	Description	Initial	Notes
-------	-------------	---------	-------

Functionality	Verify that the control system functions according to project documents.		
Automatic controls	Verify that the automatic features work ie: room combining, video detection, etc..		
Lighting controls	Verify that the lighting system presents are correctly recalled by the control system as indicated in project documents.		
Shade controls	Verify that the shade controls are correctly recalled by the control system as indicated in project documents.		
Sequencer	Verify the sequencer is controlled as noted in project documents. If no specific requirements are noted, sequencer will be powered on/of from the front panel.		

#### Video Performance

Title	Description	Initial	Notes
Video Routing & Switching	Verify that all video signals are properly routed, switched, scaled, and displayed according to project documents.		
Projector Alignment	Verify that projectors and screens provide a projected image that is properly aligned and fills the projection area.		
Projector Alignment	Verify that projector and screen are in the correct locations, correctly aligned and keystone correction is not in use.		
Projector Interactivity	Verify that projector touch sensors are calibrated and working per manufacture instructions. Provide offset hardware as needed.		
Image Scaling	Verify that all displayed images are scaled to the full native resolution of displays and projectors in all cases where scaling hardware is specified.		
Image Quality	Verify that all displayed images are correctly focused and are free from distortion.		
Aspect Ratio	Verify that all displayed images maintain the proper aspect ratio and image geometry. Key-stoning and		

	stretching should not be used. Any exceptions to this should be noted.		
Display Image setting	Displays are set to dot to dot or full. Images shall fill the screen without cropping.		
Signal Bandwidth	Verify that all equipment from endpoint to endpoint supports the resolution/data rate as indicated in the documents.		
System Certification	Verify system has been tested with industry standard testing equipment including the use of Quantum Data 780C		

- 3.2 OPERATING AND MAINTENANCE MANUALS: Include a copy of this document within the Operation and Maintenance Manuals.

END OF SECTION 27 4101



## SECTION 27 5123 - INTERCOMMUNICATION SYSTEMS

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26, 27 & 28 basic materials and methods sections apply to work specified in this section.
- C. Refer to specification 26 0553 conduit and junction box color requirements.
- D. Refer to specification 27 1500 for category and/or optical fiber cable and connectivity specifications and color requirements.
  - 1. Fiber Optic Cable: Fiber optic cable is the designated media cabling for school backbone inter-building and intra-building wiring. This includes all MDF to IDF or IDF to IDF and vertical riser applications.
  - 2. Copper Cable: Unshielded Twisted Pair (UTP) with the specified category cabling must be used for the horizontal wiring from the MDF, IDF, or CP to the individual communications outlets.
  - 3. Rack and PoE Switches Requirement: low voltage contractor is responsible for equipment racks, and/or communications cabinets unless specifically noted withing the drawings.
    - a. The racks must be installed in the MDF and IDFs to support communications systems equipment and the communications distribution system and must match the current School District Standard. Communications distribution cables must be terminated in jackfields and punch-down blocks mounted in the equipment racks or communications cabinets.

#### 1.2 ADMINISTRATIVE REQUIREMENTS:

- A. Bid Submittal:
  - 1. Equipment Costs: Breakout cost of material and labor as different line items.
  - 2. Provide separate line items for each section that you are being bid on.
    - a. Contractor shall not provide a single number with all the sections/scopes combined.
  - 3. There will be a demolition and upgrade phase at the beginning of this phase. During the construction intercom system shall be operational during school. Each Bid Package will add and remove Intercom devices from the system. Contractor to review the bid documents at each phase/Bid Package.
- B. Coordination:
  - 1. Coordinate final inspection of the systems installed, with Audiovisual (AV) Consultant, three (3) weeks in advance.
  - 2. Obtain GANTT chart for construction time frame from the General Contractor.

3. Coordinate with Electrical contractor to meet at least twice with the ceiling installer. Hold first meeting before submittal of shop drawings to coordinate the mounting condition of all ceiling-mounted AV equipment with ceiling type. During second meeting, coordinate the location of all ceiling-mounted AV equipment in each area.
4. Meet at least once with the mechanical installer prior to fabrication and installation of duct work. Coordinate depth and location of all loudspeaker and duct work in all areas.
5. Meet with Electrical contractor prior to pathway rough-in to coordinate Intercom system requirements in each area.
6. Meet at least once, prior to rough-in, with horizontal cabling installer to verify all required drop points are accounted for. Coordinate cable color according to specification 27 1500.
7. Meet at least twice with owner to coordinate network requirements. Hold the first meeting before submittal of shop drawings to coordinate network protocols, including but not limited to: IP address schedules, MAC address schedules, patchbay schedules, security requirements, and VLANs. Hold the second meeting prior to system deployment.
8. Coordinate color and finish of all system components with Architect or Electrical contractor as appropriate.
9. Coordinate all system components within millwork/furniture with millwork shop drawings prior to rough-in.
  - a. Intercom contractor shall attend the electrical pre-construction meeting per specification 26 0500.

1.3 DESCRIPTION OF WORK:

- A. This specification establishes a minimum level of quality, features, and performance for individual components as well as the integrated system.
- B. This section includes an expansion of the existing fully operational IP platform for school internal communications system incorporating school safety notifications and general communications. System is intended to provide 2-way communication within specific areas, mass notification, zone announcements, and more as indicated within this document.
- C. All bids shall be based on the expansion of the existing school districts Intercommunication and Bell Schedule Server Systems and must be compatible with the existing Rauland-Borg Systems - No Exceptions. Equipment as specified herein. The catalog numbers and model designations are that of the RAULAND BORG CORPORATION.
- D. Equipment submitted in bid proposal that has not been approved by intercom Consultant in writing will not be accepted and shall be replaced by approved equipment at contractor's expense. Equipment not listed within this specification, or contract documents, that are required for a complete and working system, shall be of professional grade and used in the same manner as needed for a complete and working system.
- E. The platform shall provide complete internal communications employing IP Technology including the minimum functions listed.

1. Two-way Loud Speaking Internal Intercommunications.
  - a. Paging and two-way loud speaking features shall be accessible from any system console or SIP connected telephone.
2. Bell Event announcement
  - a. Bell Schedules shall be easily assigned to days and changed simply with authenticated access to the system through any browser-based device.
  - b. Provide a simple calendar-based scheduling system for bells. It shall provide the ability to have an unlimited number of bell schedules.
  - c. Provide a calendar-based scheduling up to four years in advance. The system shall be capable of displaying a fully year calendar and differentiating which bell program is scheduled to run on each day in an easy-to-read format. The calendar shall be based on a standard school year and provide a selectable start month.
  - d. Provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.
3. Emergency announcement that will override any pre-programmed zones assuring that all Emergency/Lockdown etc., are heard at each and every loudspeaker location.
  - a. The system shall automatically broadcast emergency instructions throughout the entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions shall be preprogrammed and require no user intervention. The system shall provide a redundant alarm annunciation over intercom/paging speakers and is not meant to replace primary fire alarm or security systems.
  - b. The system shall have the capability of maintaining a record of all alerts that are received and provide appropriate school personnel the capability to enter information about the alert, which shall be maintained in the systems database. That information shall also be made available to appropriate school personnel in the form of a report that shows all alerts that have occurred, their date, time, and the end alert information.
  - c. Capability of prerecording emergency announcements that can be activated by a Soft Key or via a dedicated call-switch.
  - d. Shall provide ability to clear status by individual location, region, or global.
  - e. Shall provide pop up alarms on Lockdown, Shelter, or Evacuation events.
4. The system shall provide two I/O Ports on each classroom network interface, and common zone network interface which can be used as programmable inputs or outputs to control contact closures. Contact closures can be activated manually to turn on cameras, unlock doors, emergency lockdown, etc.
  - a. Connect two (2) ports to the classroom sound amplification system (CSAS) for emergency notifications to and from the classrooms. The CSAS system shall notify the system and the system shall provide feedback to the CSAS indicating the notification went through.

5. Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone.
6. The system shall be a software-controlled system, whose primary interface is a web-based portal, accessible from any authorized computer, and with assignable permission levels for each user.
7. Classroom systems and common zone network interfaces shall be capable of utilizing standard Category based infrastructure, Category 6 or better, for installation from the intermediate distribution frames only to the classroom and/or zone, allowing for only one type of wiring infrastructure within the school. Distribution of all voice signaling shall utilize a shared or dedicated IP network.
8. The platform shall provide complete internal communications employing SIP (Session Initiation Protocol) including the minimum functions listed.
  - a. Integration with any VoIP telephone system using SIP type integration. It shall allow the school(s) to upgrade or replace their telephone system without requiring the owner to replace, or lose any feature of, their internal communications (intercom) system.
  - b. Support a SIP trunk from the building's VOIP phone system to provide hands free two-way communication from all administrative telephones to any location equipped with a talkback speaker or audio system with room microphone
  - c. Provide its own SIP environment, and in the case of a failure of the schools VoIP telephone system, be capable of operating completely independently for all functions, except access from the handsets connected to the schools VoIP system.
  - d. Access remote classrooms (trailers, temporary classrooms etc.) via IP interface or room audio system with room microphone. Integration with any VoIP telephone system using SIP type integration.
  - e. It shall allow the school(s) to upgrade or replace their telephone system without requiring the owner to replace, or lose any feature of, their internal communications (intercom) system.
  - f. Any authorized administrator shall be able to call from outside the school into any classroom, zone or entire school directly via the School District supplied SIP enabled Telephone Network. This shall allow remote monitoring, call-in annunciation and two-way conversation from outside the facility as well as paging into the system. (Compliance with NEMA Standard SB-40 for emergency communications in K-12 Schools)
9. The system shall utilize a shared data network (VLAN enabled) or dedicated network as means of distribution for all voice overhead paging, emergency paging, emergency tones, intercom, and class change tones.
- F. The system shall support receiving multiple levels of priority, which shall be user definable, that is appropriate for the size of the project. Each end point to place a minimum of a; normal. emergency, ok, and help level priority call depending on the system state at the time of the notification.
- G. Authorized system users shall be able to create a minimum of twenty (20) automated sequences with emergency instructions, emails and relay activations and replay them.

Automated message strings shall be, manually played from a single-button access on the console, on a SIP connected telephone, a panic button or from the web interface.

- H. The platform shall synchronize its system time to the network timeserver or a web-based time server.
- I. Installation shall be locally survivable for intercom, paging bells, and emergencies such as lockdown, even when the district connection is unavailable.
- J. Input plates shall match the color and style being used throughout the project.
- K. Contractor is responsible for coordinating with all other trades for equipment locations, mounting requirements, supports and plenum space requirements.
- L. Interconnect the Fire Alarm system to the intercommunications system such that upon activation of any initiating device, a preset audible alarm will be sent to all intercom speakers. In addition, the contractor shall provide all controls necessary between the two systems such that upon silencing the alarm on the fire alarm panel, it automatically silences the audio file in the intercom system.
- M. Interconnect the Access Control system to the intercommunications system such that upon activation of an Emergency Lockdown or Preventative Lockdown from the administrative console, web browser, app, etc, a communication protocol will be sent from the intercom system to the access control system that will allow for all controlled doors to be locked, a designated campus wide communication throughout the building, emails, SMS text, etc. A minimum of two types of initiations process shall be programmed e.g. "Emergency Lockdown or "Preventative Lockdown" In addition, the contractor shall provide all controls necessary between the two systems such that the system can easily be reprogrammed to meet the needs of the School District.
- N. AV contractor shall participate in a mandatory pre-construction meeting no more than (60) days prior to ordering equipment, and before work can begin. Contractor is responsible for coordinating meeting. The meeting will be held at AV Consultant's office. All submittals, shop drawings, and bill of materials shall be completed and submitted to AV Consultant for review (8) working days prior to this meeting.
  - 1. AV contractor shall attend the electrical pre-construction meeting per specification 26 0500.

1.4 QUALITY ASSURANCE:

A. MANUFACTURERS:

- 1. Firms regularly engaged in manufacturing of; sound equipment, components and accessories, of types, capacities and characteristics required, whose products have been in satisfactory use in similar service for not less than five (5) years. Equipment supplier shall be authorized representative of the manufacturer of each major piece of equipment and be currently authorized by the manufacturer to furnish, install and service that particular equipment.

B. INSTALLER:

- 1. Qualified with at least 5 years of successful installation experience with similar systems.

2. Integrating firm shall have worked satisfactorily for a minimum of (5) years of completing systems equal to this scope, quality, type and complexity.
  3. Key personnel assigned to the project shall each have minimum of (10) years of experience in completing systems equal to this scope, quality, type and complexity.
  4. Contractor shall be a factory authorized distributor of all equipment specified for the geographical area of the project.
  5. Contractor shall maintain complete installation and service facilities for the duration of the project contract.
  6. Contractor shall have current manufacturer certificates for system and equipment listed within this specification.
  7. All contractors bidding on this project must have local representation that is within 4 hours of the job site.
  8. Any contractor that cannot meet this requirement shall not bid on this project.
- C. Contractor must follow the standards described within:
1. BICSI/AVIXA AV Design Reference manual.
  2. ANSI/AVIXA 2M-2010 Standard guide for Audiovisual Systems Design and Coordination Processes.
  3. ANSI/AVIXA 10:2013 Audiovisual Systems Performance Verification Guide.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.
- E. Comply with NFPA 70 and with NEMA Standard SB-40 for Emergency Communications in K-12 schools.
- F. Comply with UL 60950.
- 1.5 SUBMITTALS: Refer to Section 26 0502 for requirements.
- A. The following items shall be included in the shop drawings submittal.
1. All submittals shall be submitted in a digital format with bookmarks for each section of equipment. Any submittals that are partial or incomplete shall be rejected and count as one submittal against the submittal allowance.
  2. Project manager to provide written proof, signed and dated, that shop drawings and/or brochure has been checked for accuracy prior to submittal. Shop drawings to comply in all respects with the requirements of the contract drawings and specifications for this project.
  3. Provide a complete bill of materials for all components, accessories and hardware to be provided in order to assemble a complete and working system as described within the contract documents.
  4. Submit manufacturer's data and installation details for all devices, plates, cables and similar equipment. Product data showing multiple options, products and/or models shall be clearly marked identifying the specific options, products and/or models being provided.
  5. Submit dimensioned drawings and device wiring layouts for Audio, Video, Control, and power.
  6. Submit equipment rack elevation diagrams.

7. Submit all manufacturer training, 3rd party and/or organization certificates for each equipment and/or systems required for the implementation of this specification.

1.6 WARRANTY:

- A. Systems shall be guaranteed for a period of one (1) year from the date of substantial completion against defective materials, inferior workmanship or improper installation adjustment. Guarantee shall cover all parts and labor.
- B. If system failure causes audiovisual system to be inoperative or unusable for its intended purpose, contractor, when notified of the problem, shall repair system so it will be operational and usable within three (3) business days. If defective components cannot be repaired in time, provide temporary equipment as required.
- C. Contractor shall supply a one (1) year warranty on all system programming from the date of substantial completion. During this time period, upon owner request, the contractor shall provide programming changes up to four (4) times free of charge. During this time the programs shall be password protected. At any time during the (1) year, the owner can terminate the warranty and request the programming of each system. At this time the programs are to be turned over to the owner and all passwords are to be removed. The owner shall own all rights to the programming after this time, to be used in this facility.
- D. Contractor shall honor equipment warranties for term established by manufacturer if greater than warranty time frame mentioned above.
- E. Prior to the end of the 1-year warranty. The Intercom Integrator shall preform the following:
  1. Three (3) months prior to end of warranty remind the owner and design consultant that the end of the warranty is approaching. At this time coordinate the events below with the owner and notify the design consultant of the time of the walk through(s).
  2. One (1) month prior to end of warranty, walk through campus and verify all components are working. Supply list of components with location, type equipment and status to the design consultant and Owner. Correct any and all malfunctions as necessary.

PART 2 - PRODUCTS

2.1 GENERAL:

- A. The platform shall utilize state of the art IP Technology, Call-in Notification, School Safety Paging and Evacuation tones, IP infrastructure, Atomic Time Synchronization with Class Change Tones utilizing multiple, programmable schedules for each zone, Two-way hands-free Internal Intercommunications and Paging, and Program Distribution. The system shall be easy to learn and operate. All standard programming shall be web based and user friendly to allow the system administrator the ability to easily program system features.
- B. Provide complete and satisfactorily operating school communications and school safety as described herein, using materials and equipment of types, sizes, ratings, and performances as indicated. Use materials and equipment that comply with referenced

standards and manufacturers' standard design and construction, in accordance with published product information. Coordinate the features of all materials and equipment so they form an integrated system, with components and interconnections matched for optimum performance of specified functions.

- C. Intercom paging system power and network intercom interface:
  - 1. Shall allow users to install intercom paging systems spanning multiple building or facilities connected through a VLAN. Provide a 100/1000 Ethernet switch port configured on a dedicated VLAN.
  - 2. All Network interfaces used in the classroom and for the common zones shall be powered via PoE+ from the network switches.
    - a. PoE+ switches and network cabling from MDF (Main Distribution Frame) and IDF (Intermediate Distribution Frame) to devices.
- D. All network switches shall include an uninterruptable power source to provide adequate runtime. In the event the school has a generator the UPS systems shall hold the switches long enough until generator power can be provided.
- E. The platform shall be a single electronic system consisting of intercom channels, (classroom) IP loudspeakers, corridor loudspeakers, inside and outside horns, call-in switches, and SIP phone integration.
- F. Call-ins shall:
  - 1. Be automatically annunciate (display of priority and location) to administrative consoles, SIP enabled phones and outside phones.
  - 2. Be programmed to automatically change priority and annunciation route based on age of call-in and original priority.
  - 3. Have priority and annunciation routing changed by user action from a console or SIP enabled phone.
  - 4. Be annunciation routing shall include playing pre-recorded audio over speakers, sending a pre-configured e-mail and/or activating relays.
- G. The platform shall lend itself to expansion by simple addition of hardware modules.
- H. The platform shall directly connect to the WAN/LAN without the need for a separate server at each school location. Configuration, including bell schedules, calendars, and emergency sequences can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.
- I. The platform shall provide the ability to initiate school safety paging announcements, evacuation tones and take cover tones from any telephone within the facility or outside the facility to any other location within the facility or district.
- J. The platform shall provide the ability to selectively communicate or monitor individual classrooms in emergency situations from any telephone within the facility or outside the facility to any other location within the facility; all communication within the classroom shall be hands free and will not require any interaction by the classroom user.
- K. IP addressable loudspeaker modules for individual rooms shall be system programmable and may be assigned any two, three, four, five or six digit number as well as name and description. Any extension may be reassigned at any time.
- L. IP-enabled two way voice communication shall be available from any provided telephone



or administrative console through any IP loudspeaker in the system. This shall allow hands free communication to any classroom or any individual loudspeaker unit. A programmable pre-announce tone shall sound immediately before the intercom path is opened and a supervisory tone shall continue to sound at regular intervals when loudspeaker monitoring is active, complying fully with all privacy legislation. Pre announce tone and supervisory tones shall be disabled during designated emergencies automatically.

- M. Integrated Master Clock with unlimited schedules, unlimited events, and automatic Daylight Savings time correct. Up to 5 schedules may be active on any given day for each school. User shall be able to select from 25 standard included tones or unlimited user created and uploaded audio files for class change signaling and messaging. In addition scheduled events shall include relay actions and email notifications. The platform shall allow control of the bell schedules via the district WAN/LAN without the need for a separate computer at the school location. Bell schedules can remotely be created, changed, stored and downloaded to the system by an authorized user from a browser-based interface.

## 2.2 SYSTEM FUNCTIONS/SOFTWARE

### A. Server Software TCU2000SW

1. Provides district wide paging, bell event scheduling, emergency notification and configuration for entire district.
2. Reports on feature usage, system activity, etc. shall be available from the district-wide web interface.
3. Ability to perform configure system and initiate system features via district wide web based interface.
4. The software has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server
5. The software will provide a web-browser to deliver district wide emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The software must be capable of automatically notifying district personnel via the WAN of an alarm condition.
6. The software can automatically broadcast page emergency instructions via associated system hardware throughout an entire district when an alarm (e.g. lockdown, lockout, security, fire) is initiated via the web-based interface. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging loudspeakers and is not meant to replace primary fire alarm or security systems
7. The software shall support VoIP Telecenter Campus Controllers for a minimum of 1000 facilities.
8. The software shall support a minimum of 50,000 IP Loudspeaker modules, district wide.

### B. VoIP Single Campus Controller Rauland-Borg Telecenter Series TCC2000 with the following features and capabilities:

1. Provides call routing for paging and intercom for a single facility

2. System shall connect to the district provided Telephone Network via a SIP connection.
3. The VX Works based Operating System and system programming database shall be stored in non-volatile flash memory. The Operating System can be easily upgraded through configuration without requiring replacement of any chips.
4. Support a flexible numbering plan allowing two, three, four, five, or six digit extensions.
5. SIP interface to a district provided Telephone Network shall be capable of allowing connected phones to display classroom call-ins, answer internal intercom call-ins, make pages and change priorities of call-ins in progress.
6. Direct Dialing, two way amplified voice intercom between any provided telephone or admin console and loudspeaker without the use of a press to talk or talk listen switch.
7. Ability to place up to 5 levels of call-in from any call in switch per area.
8. The ability to answer intercom call-ins registered at pre-selected telephones.
9. The ability to automatically escalate incoming call-ins to an alternate administrative console or SIP telephone or group of telephones if they remain unanswered for a predetermined amount of time.
10. The ability to remotely locate IP Campus Controller. The controller shall not need direct connection to any classroom via home run or distributed wiring. It shall communicate solely through the IP LAN network.
11. Single button access from any telephone on the system to distribute emergency announcements within the facility to all or select locations equipped with loudspeakers. Emergency announcements originating from any assigned administrative telephone shall have priority over all regular system functions.
12. Store a minimum of 48 hours of Bell Event Schedules, all emergency notification sequences as well as facility wide configuration.
13. System has the ability to sync system time to the Atomic Clock Signal or to the school's or districts network time server.
14. System's SIP Interface shall provide:
  - a. Audio paging access from any telephone to any single intercom loudspeaker, zone (group) of intercom/paging loudspeakers, or all loudspeakers/paging horns throughout the entire facility.
  - b. Single button access from any telephone on the system to initiate alarm signals within the facility to all or select locations equipped with loudspeakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
15. The system will have the ability to utilize a web-browser and USB microphone to deliver district wide live emergency paging, pre-recorded messages and tones from any authorized computer in the facility or the district. The system must be capable of automatically notifying district personnel via the WAN of an alarm condition.
16. The system can automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and

require no user intervention. The system provides redundant alarm annunciation over intercom/paging loudspeakers and is not meant to replace primary fire alarm or security systems.

C. IP addressable Modules TCC2011:

1. System shall provide multiple IP addressable modules for intercom, paging and relay activation.
  - a. All modules are POE 802.3af compliant
  - b. All Modules support DHCP
  - c. All Modules connect to network with a single RJ45 connector
2. IP Loudspeaker Module shall interface to school's data network, a loudspeaker, and multiple call switches.
  - a. A minimum of 5 levels of call-in can be placed from an IP Loudspeaker Module. The call-ins route to designated administrative consoles and select SIP connected telephones and can only be cleared from the system once answered. If a call-in is not answered within a preprogrammed time the call-in may reroute to other telephones and consoles, and announce over selected or all loudspeakers.
  - b. The ability to belong to one or more of a minimum of 100 independent zones for zone paging, program/music distribution zones and class change tone reception; this assignment is a programmable function, change able by time of day. Each IP Loudspeaker Modules location shall be programmed in software to belong to any combination of software zones. Software/hardwired zones must be configured as part of an unlimited number of district wide groups for school district emergency announcements. These district announcements must be accessed via microphone, a web-browser or telephone.
  - c. IP Loudspeaker Modules shall be designed to mount near ceiling and wall loudspeakers and in the plenum space.

D. IP-addressable Zone Paging Module TCC2022:

1. Zone paging module shall connect multiple loudspeakers for all page, zone paging, bells, audio events and, emergency notification.
2. Zone Paging Modules shall be rack and wall mountable.
3. Zone Paging modules shall be able to belong to one or more of 100 independent zones for live paging, bells, pre-recorded audio and emergency notification

E. IP Addressable Aux I/O Module TCC2033:

1. Aux I/O Module shall have two input contacts and two output contacts.
2. Input and output contacts are individually addressable.
3. Aux I/O Module shall be wall and rack mountable.
4. User can program relays to be activated manually, through an event/bell schedule and during emergency notification

F. IP Addressable Program Line Input Module – Rauland Model TCC2055

1. Line Input Module converts stereo or mono line-level analog audio to IP-Based Data for use in the Telecenter U system.
2. Equipped with 3.5mm (headphone style) input socket.

3. Desktop or rack mountable with Rauland Model TCC2099 Universal Rack Mounting Kit.
4. Includes a male 3.5mm to dual male RCA connector cable.
- G. IP Addressable Gateway TCC2024:
  1. (24) Port gateway for intercom, zone paging, emergency notification program/music and event tone distribution.
  2. 25 Watt amp with 5 watt maximum per port.
- H. IP Addressable Administrative Console TCC2044:
  1. A full color screen with 4 soft keys, 3 line select, volume control, push to talk, speakerphone mode and left/right and up/down scrolling.
  2. Audio paging access from any Console to any single intercom loudspeaker, zone (group) of intercom/paging loudspeakers, or all loudspeakers/paging horns throughout the entire school.
  3. Programmable soft key access from any console on the system to initiate alarm signals within the school to all or select locations equipped with loudspeakers. A minimum of 25 separate distinct alarm signals shall be provided. Alarm signals originating from any assigned administrative telephone shall have priority over all regular system functions.
  4. Programmable soft key access from any console to automatically broadcast page emergency instructions throughout an entire school when an alarm (e.g. lockdown, lockout, security, fire) is tripped or manually activated. The emergency instructions are preprogrammed and require no user intervention. The system provides redundant alarm annunciation over intercom/paging loudspeakers and is not meant to replace primary fire alarm or security systems.
  5. Ability to perform intercom to any single IP Addressable Loudspeaker Module.
  6. Ability to display 3 call-ins at a time on the screen, with unlimited number of call-ins annunciating and the ability to scroll to view all call-ins.
  7. Ability to upgrade a call-in via soft key
  8. Ability to change which bell event schedule(s) are active on current day.
  9. Programmable soft key access from any console for activating relays, school wide
  10. Ability to maintain, along with controller and other IP Modules system functions, including intercom, bells and paging in the event of district wide connection loss.
  11. Provide (3) administrative consoles. One in each reception area and another in the principal's office. (2) of the (3) locations are in the existing building. coordinate with the horizontal cabling installer for location of data drops for consoles.
- I. Normal/Emergency Call Switch – Rauland TCDPB2 Dual Level Call In Switch Cancel
  1. Normal/Emergency Call Switches indicated on the drawings shall provide the following functions and features:
    - a. One (1) “Normal” call switch that shall activate a distinctive “NORM” level call from a single button activation. The button shall be clearly marked “NORM” and will route the call-in to any one or more

Administrative Telephones or SIP interface to offsite telephones. This button may also be used as a “check-in” button during crisis situations.

- b. One (1) “Emergency” call switch that shall activate a distinctive “EMERGENCY” level call from a single button activation. The button shall be red in color and shall be clearly marked “EMERGENCY” and will route the call-in to any one or more Administrative Telephones or SIP interface for quick and easy response from an Administrative Telephone or off-site telephone.

J. SIP Gateway

1. The SIP Gateway shall provide a communications path to the phone system from the intercom system.

2.3 AMPLIFIER AND LOUDSPEAKERS:

A. Audio Paging/Program Amplifiers: Atlas Sound – CP400, Powersoft – Mezzo 322 A, Stewart Audio – CVA25-1 70V, and/or Manufacturer’s equivalent.

1. Power amplifier(s) shall be provided to provide a minimum of 2 watts of power to all paging loudspeakers, and 15 watts of power to all paging horns.
2. The maximum load on the paging/program amplifiers shall be 80% of the rated maximum output of the amplifiers.
3. Provide 25 or 70 volt transformer output for all zones that connect more than 3 loudspeaker together and/or the distance from amplifier to the loudspeaker is greater than 25’.
4. Any exterior zone shall be connected to a minimum of 200 watt amplifier channel.

B. Loudspeakers:

1. AtlasIED and Quam loudspeaker assemblies are the basis of design. Intercom manufacturer equivalent loudspeakers are allowed if they meet the function and form of the loudspeakers listed below.
2. Loudspeaker cabling for common zones shall use a 16 AWG 2-pair stranded conductor cable assembly unless otherwise noted. Refer to Audiovisual Cable and Conduit Schedule on the drawings for approved cabling manufacturer.
3. Type ‘IC1’ - loudspeaker assembly:
  - a. Quam – System 5 or equal
  - b. 1’x2’ ceiling tile replacement loudspeaker with 5 oz. magnet and 5 watt 24/70V transformer. 92dB SPL 1W/1M with 99dB max SPL at maximum tap. 65Hz – 17kHz frequency response ±3dB and 100-degree dispersion angle.
4. Type ‘IC1’ - loudspeaker assembly:
  - a. Atlas – SD72W w/ 81-8R mounting ring and CS95-8 enclosure
  - b. Quam – C10X/BU/WS w/ SSB-2 mounting ring and ERD-8U enclosure
  - c. Manufacturer equivalent
  - d. Gyp loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response ±3dB and 90-degree dispersion angle.
5. Type ‘IC2’ - loudspeaker assembly:

- a. Atlas – SD72W w/ 76-8 mounting ring and BMTT95-8 enclosure
  - b. Quam – C10X/BU/WS w/ SSB-7 mounting ring and ERD-8U enclosure
  - c. Manufacturer equivalent
  - d. Gyp loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response  $\pm 3$ dB and 90-degree dispersion angle.
6. Type 'IC3' - loudspeaker assembly:
  - a. Atlas – SD72W w/ BMTT95-8 enclosure
  - b. Quam – C10X/BU/WS w/ ERD-8U enclosure
  - c. Manufacturer equivalent
  - d. Open ceiling direct mount to structure loudspeaker with 10 oz. magnet and 5 watt 24/70V transformer. 95dB SPL 1W/1M with 102dB max SPL at maximum tap. 60Hz – 8kHz frequency response  $\pm 3$ dB and 90-degree dispersion angle.
7. Type 'IC4' - loudspeaker assembly (lay-in tile IP);
  - a. Intercom Manufacturer specific assembly with an IP Addressable module and loudspeaker.
8. Type 'IW1' - loudspeaker assembly:
  - a. Quam – 8C5PAX/TBLU w/ ES-8 enclosure and BS8W grill
  - b. Indoor recessed wall 8" loudspeaker with 5 oz. magnet and 5 watt 24/70V transformer. 92dB SPL 1W/1M with 99dB max SPL at maximum tap. 65Hz – 17kHz frequency response  $\pm 3$ dB and 100-degree dispersion angle.
9. Type 'IW2' - loudspeaker assembly:
  - a. Atlas – VTF-152UCN or VTF-157UCN w/ AR Adapter Ring
  - b. Exterior recessed wall 4" loudspeaker with 5 watt 24/70V transformer. 96dB SPL 1W/1M with 107dB max SPL at maximum tap. 600Hz – 5.5kHz frequency response  $\pm 5$ dB and 170-degree dispersion angle.
10. Type 'IW3' loudspeaker assembly:
  - a. Atlas – AP-15T
  - b. Exterior Horn with compression driver and 15 watt 24/70/100V transformer. 106dB SPL 1W/1M with 120dB max SPL at maximum tap. 400Hz – 14kHz frequency response  $\pm 5$ dB and 70-degree dispersion angle.
- C. UPS – Juice Goose – SCV-30001 or equal
  1. Contractor to verify UPS load requirements prior to purchase of UPS. Intercom system shall maintain power for 30 minutes after building loses power.
- D. Cabling:
  1. Provide and install appropriate number of analog and horizontal cables, patch cables, for all terminated data drops, between switches, etc. so that building-wide networking will be operational once all installation is complete.
    - a. Provide manufacturer recommended cabling for all locations shown on plans.
      - i. Horizontal/Category provided per specification 27 1500 (i.e. IP addressable Speakers, Classroom Modules, Call Switches, Zone Modules, Console, Controller, etc.)

- ii. Loudspeaker cabling shall be 18 gauge or better. Refer to drawings for cable types and requirements.
- b. Provide cabling rated for the environment that it is installed in (i.e underground conduit, conduit in slab on grade). All cabling installed in wet locations shall be listed for use in wet locations.

2.4 ZONES, PROGRAM DISTRIBUTION, CLOCK/TIME SIGNALING SYSTEM

- A. Separately addressable paging zones shall be provided as indicated on the drawings. Zones shall be capable of being grouped for various call scenarios as defined or requested by the owner.
- B. Refer to the intercom drawings for identification of zones, zone types, and ceiling construction type.
  - 1. Individual zones are designated with "Z-ID".
  - 2. Common and exterior distributed zones are identified with a unique zone number "Z-#X#".
  - 3. Intercom drawings are intended to be printed in color in addition to having the zone information under the room tag.
- C. Space requirements:
  - 1. Classrooms/Teaching spaces.
    - a. The IP module/loudspeakers for each space shall be utilized for the intercommunication system.
    - b. One (1) Call switch shall be provided in each room near the CSA antenna location. Refer to drawings for location of devices.
    - c. One (1) Clock located above the entrance door.
  - 2. Shared spaces between Classrooms/Teaching spaces.
    - a. The IP module/loudspeakers for each space shall be utilized for the intercommunication system.
    - b. One (1) Call switch shall be provided on the wall adjacent to the main hallway.
    - c. One (1) Clock located above the entrance door.
    - d. These rooms will be used as shelter in place rooms for adjoining classrooms.
  - 3. Specialty Teaching spaces with high ambient noise floor (Wood/Metal/AG shops, Band/Choral/Orchestra rooms, etc).
    - a. Distributed ceiling recessed loudspeakers (Qty. as required) at 14' by 14' minimum spacing, type as required for ceiling construction.
    - b. Visual strobe located in a highly visible area.
    - c. One (1) Call switch shall be provided at the primary teaching station. Coordinate location of primary teaching location with drawings.
    - d. One (1) Clock located above the entrance door
  - 4. Private Offices, Conference rooms, Faculty Lounges & Work Rooms (outside of the main office/administration suite)
    - a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.
    - b. Connect to adjacent corridor zone you enter the office from.
    - c. Offices off of a classroom shall be on the same zone as the classroom.

- d. Refer to floor plans for offices that require an individual zone.
5. Gymnasium
  - a. Wall mounted horn type loudspeaker above the entrance door. If there is a dividable curtain provide a loudspeaker for each side along with one on the stage, if applicable.
  - b. Additional loudspeakers may be required as needed to maintain adequate coverage ( $< 6\text{dB}$  level variation).
  - c. One (1) Call switch shall be provided co-located with any light switches adjacent to each entrance from within the school.
6. Cafeteria/Commons/Dining
  - a. Ceiling mounted loudspeakers, Qty. and type as required for ceiling construction and adequate coverage ( $< 6\text{dB}$  level variation).
7. Kitchen
  - a. Ceiling mounted loudspeakers, Qty. and type as required for ceiling construction and adequate coverage ( $< 6\text{dB}$  level variation).
  - b. One (1) Call switch shall be provided co-located with any light switches adjacent to main entrance.
  - c. Within the Kitchen office provide a two-way system with call button and loudspeaker.
8. Corridors, Vestibules & Open Collaboration/Circulation areas
  - a. Distributed ceiling recessed loudspeakers (Qty. as required) at 20' minimum spacing, type as required for ceiling construction.
  - b. Rooms that are wider than 25' shall require an additional row of loudspeakers and located on a maximum of a 20' x 20' spacing centered in the room.
  - c. Coordinate with ceiling devices and locate adjacent to smoke detectors when within few feet of one. Loudspeakers shall be in line with any lighting within the space
  - d. Provide a minimum of one (1) loudspeaker for each space type
9. Stairwells
  - a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.
  - b. Connect to the adjacent corridor zone unless otherwise specified.
10. Restrooms
  - a. One (1) ceiling mounted loudspeaker, type as required for ceiling construction.
  - b. Connect to the adjacent corridor zone
  - c. Do not provide loudspeakers in single use restrooms adjacent to a corridor zone. Locate corridor loudspeakers within 10 to 12 feet of the door.
11. Administration Suite (Private offices, Conference rooms, Nurse areas, work rooms, reception, etc. within the main administration suite)
  - a. Distributed ceiling recessed loudspeakers (Qty. as required) at 20' minimum spacing down corridors and 14' x 14' in open areas, type as required for ceiling construction.
  - b. Provide a minimum of one (1) loudspeaker for each space type.



- c. Provide a minimum of one (1) loudspeaker on an individual zone in the reception area and adjacent areas where it would be heard in the reception area. General pages from the reception area shall not play over this zone, it shall only be used for prerecorded messages.
- 12. Building Exterior
  - a. Distributed recessed loudspeakers (Qty. as required) to cover all sides of the building and all entrances.
  - b. Coordinate and co-locate loudspeaker rough-in with exterior fire alarm horn strobe locations.
  - c. Provide unique zone for each side of the building (North/South/East/West)
  - d. Provide 'IW3' type loudspeakers on areas with:
    - i. Playground equipment
    - ii. Fields
    - iii. Other play surfaces
  - e. Provide 'IW2' type loudspeakers on the front of the building and in locations where the property line is less than 30' from the building.
- 13. Rooms smaller than 100 sqft and that are adjacent to a corridor/hallway will not require a loudspeaker when an announcement is audible within the room. Audible within the room shall be defined as 15 dB above the ambient noise within the room.
  - a. Vestibules are excluded from small rooms and will require a loudspeaker tied to the adjacent corridor zone.
- 14. Field coordinate the tap setting on each loudspeaker to be 15dB above the ambient noise floor. The ambient noise floor shall be measured when the area is fully occupied. The following areas have the anticipated noise floor:
  - a. Hallways – 80 dB
  - b. Classrooms – 70 dB
  - c. Offices/conference rooms – 60 dB
  - d. Gym/multipurpose rooms – 85 dB
  - e. Exterior areas – Max tap setting
- D. All class-change bell signaling shall be sounded over the intercommunication system.
  - 1. Each dialing administrative console in the system shall be programmable for the following options:
    - a. Allow zone paging.
    - b. Allow All-Page announcements.
    - c. Allow Executive Override.
    - d. Allow Emergency paging.
    - e. Allow activation of Time Zone tones.
    - f. Set the priority level and target display of "normal" calls.
    - g. Set the priority level and target display of "emergency" calls.
    - h. Assignment of architectural number.
    - i. Class of Service.
    - j. Assignment of associated speaker to paging zone.
    - k. Automatic Call-Back-Busy.
    - l. Call Forward-No Answer.
    - m. Call Forward-Busy.

- n. Allow activation of security monitoring functions on a per room and per zone basis.
- E. All class-change signaling shall be sounded over system loudspeakers as programmed.

### PART 3 - EXECUTION

#### 3.1 GENERAL

- A. Wiring shall be installed in metallic conduit to cable trays and provided with necessary junction and pull boxes. All wiring shall be color coded and in accordance with the manufacturer's instructions, local and national codes. Care shall be exercised in wiring to avoid damage to the cables. All boxes shall be plumb and square. Cables shall be pulled continuous without splicing, leaving ends in lengths as directed by the manufacturer's representative.
- B. After all circuits and cables have been pulled and completed from one extremity to the other, the electrical contractor shall check all circuits free of opens, shorts and grounds. The electrical contractor shall identify and tag all cables at the head end.
- C. Provide all equipment, wiring, conduit, boxes, rough-in, etc., according to the plans and specifications.
- D. The manufacturer's representative shall make all final connections to the equipment, shall test and adjust the systems, and shall instruct the proper parties as to care and operation.
- E. Any additional equipment required for a fully functional system to meet the intent of the specifications shall be provided whether or not specifically listed herein.
- F. Mount punch down block for system terminations, within the equipment rack.

#### 3.2 INSTALLATION OF SOUND SYSTEMS:

- A. Install sound systems as indicated, in accordance with equipment manufacturer's instructions, and with recognized industry practices, to ensure that system equipment complies with requirements. Comply with requirements of NEC and applicable portions of NECA's "Standard of Installation" practices.
- B. Carefully match input and output impedances and signal levels at signal interfaces. Provide matching networks where required.
- C. Coordinate with other electrical work, including cable/wire, raceways, electrical boxes and fittings, as appropriate to interface installation of clock and program systems work with other work.
- D. Control Circuit Wiring:
  - 1. Install control circuits in accordance with NFPA 70 and as indicated. Provide number of conductors as recommended by system manufacturer to provide control functions indicated or specified.
  - 2. The contractor shall mount a main distribution frame behind the Integrated Electronic Communications Network console. All wires shall be laid down on terminal punch blocks and identified by the actual room location it serves. All the communications points shall be wired into this main distribution frame, laid

- down in sequence, and identified by which line it is on and the point position it serves.
3. All housings are to be located as specified and shown on drawings.
  4. Make installation in strict accordance with approved manufacturer's drawings and instructions.
  5. The contractor shall provide necessary transient protection on the AC power feed, all station lines leaving or entering the building, and all central office trunks. All protection shall be as recommended by the equipment supplier and referenced to earth ground.
- E. Wiring Within Enclosures:
1. Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.
  2. Provide physical isolation from each other for speaker-microphone, line-level, speaker-level, and power wiring. Run in separate raceways, or where exposed or in same enclosure, provide 12 inch minimum separation between conductors to speaker-microphones and adjacent parallel power and telephone wiring. Provide physical separation as recommended by equipment manufacturer for other Integrated Electronic Communications Network system conductors.
- F. Weatherproofing:
1. Provide weatherproof enclosures for items to be mounted outdoors or exposed to weather.
- G. Repairs:
1. Wherever walls, ceilings, floors, or other building finishes are cut for installation, repair, restore, and refinish to original appearance.
- H. Equalize systems using industry recognized practices and equipment.
- I. Pathway Requirements:
1. General:
    - a. All pathways shall be designed, constructed, grounded and installed in accordance with all recommendations delineated within TIA 569-B and Standard TIA 942.
    - b. Prior to placing any cable pathways or cable, the contractor shall survey the site to determine job conditions will not impose any obstructions that would interfere with the safe and satisfactory placement of the cables. Arrangements to remove any major obstructions not identified on plans need to be determined at that time with the Engineer.
  2. Conduits:
    - a. Contractor shall provide a minimum of 1-1" EMT conduit from device to accessible ceiling space unless otherwise noted. Then utilize non-continuous cable support from devices to connecting device. Refer to symbol schedule for specific conduit requirements.
      - i. Provide non-continuous open top cable supports every 5' above accessible ceiling.

- b. Achieve the best direct route parallel with building lines with no single bend greater than 90 degrees or an aggregate of bends in excess of 180 degrees between pull points or pull boxes.
  - c. Provide large radius elbows on all bends.
  - d. Conduit runs shall not have continuous sections longer than 100 feet without a pull box. Refer to rough-in schedule for conduit fill capacity.
  - e. AV conduits should not be routed over or adjacent to heat sources such as boilers, hot water lines, or steam lines. Neither should they be routed near large motors, generators, photocopy equipment, or electrical power cabling and transformers.
  - f. After installation, conduits shall be clean, dry, unobstructed, capped for protection, labeled for identification, reamed and fitted with bushings.
  - g. A 200lb pull cord (nylon, 1/8" minimum) shall be installed in any empty conduit.
- 3. Open Top Cable Support Requirements:
  - a. Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables
  - b. Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
- 4. Pull Box Requirements:
  - a. NEC sized pull boxes are not acceptable. Follow BICSI and EIA/TIA 569-B guidelines for pull box sizing.
  - b. Provide pull boxes in sections of conduit that are 100 feet or longer, contain more than two 90 degree bends, or contain a reverse bend.
  - c. Conduits that enter a pull box from opposite ends should be aligned.
  - d. Pull boxes shall have a length 12 times the diameter of the largest conduit.
  - e. All pull boxes must be accessible.
- J. Cabling System:
  - 1. Follow T568B scheme for copper category cabling terminations.
  - 2. Provide a minimum 6" service loop in each AV system junction box. Cables shall be coiled in the in-wall boxes if adequate space is present to house the cable coil without exceeding manufacturers bend radius.
  - 3. In a false ceiling environment, a minimum of 3 inches shall be maintained between cable supports and false ceiling. At no point shall cable(s) rest on lay-in ceiling grids or panels.
  - 4. Cable shall be installed above fire-sprinkler systems and shall not be attached to the system or any ancillary equipment or hardware. The cable system and support hardware shall be installed so that it does not obscure any valves, fire alarm conduit, boxes, or other control devices.
  - 5. Cables shall not be attached to ceiling grid seismic support wires or lighting fixture seismic support wires. Where support for AV cable is required, the contractor shall install appropriate carriers to support the cabling.
  - 6. Any cable damaged or exceeding recommended installation parameters during installation shall be replaced by the contractor prior to final acceptance at no cost to the Owner.

7. Pulling tension for balanced twisted pair shall not exceed 25lbf and for optical fiber shall not exceed 50lbf.
  8. Pair untwist at the termination shall not exceed 0.125". The cable jacket shall be maintained as close as possible to the termination point.
  9. Cable shall not be draped on, tied or otherwise secured to electrical conduit, plumbing, ventilation ductwork or any other equipment. Cable shall be secured to building supports or hangers or to additional blocks or anchors specifically installed for this purpose.
- K. Cabling groups and conduit separation:
1. Refer to "CABLING GROUPS AND CONDUIT SEPARATION SCHEDULE".
- L. Firmly secure all equipment in place that is not intended for portability.
- M. Mount projectors permanently and provide mechanical index ensuring precise alignment of the projected image.
- N. Provide adequate structural support for AV system components. Provide fastenings and supports with a safety load factor of at least five.

### 3.3 GROUNDING:

- A. All grounding and bonding shall be done according to ANSI J-STD-607-A, TIA 942, and NEC.
- B. All cabinets/racks shall utilize paint piercing grounding washers, to be used where rack sections bolt together, on both sides, under the head of the bolt and between the nut and rack.
- C. All racks shall further utilize a full-length rack ground strip attached to the rear of the side rail with the thread-forming screws provided to ensure metal-to-metal contact. Similar to Panduit RGS.
- D. All active equipment shall be bonded to ground. If the equipment manufacturer provides a location for mounting a grounding connection, that connection shall be utilized. All active equipment shall be bonded using the appropriate jumper for the equipment being installed using the thread-forming screws. Similar to Panduit RG.
- E. Racks shall have individual, appropriately sized conductors bonded to the grounding backbone. Do not bond racks or cabinets serially – daisy-chained rack grounds will not be accepted.
- F. Refer to electrical diagrams for additional ground connection requirements.

### 3.4 LABELING

- A. The contractor shall develop and submit for approval a labeling system for the cable installation. The Owner will negotiate an appropriate labeling scheme with the contractor. At a minimum, the labeling system shall clearly identify all components of the system: racks, cables, panels and wall plates. The labeling system shall designate the cables origin and destination and a unique identifier for the cable within the system. All labeling information shall be recorded on the as-built drawings and all test documents shall reflect the appropriate labeling scheme.
- B. All labels shall meet UL 969 requirements for legibility, defacement and adhesion

requirements. Handwritten labels are not allowed. All labels shall maintain consistent typeface, size and color.

- C. Provide laminated plans (minimum size 11x17) of all AV as-built plans (including riser diagrams) intercom rack. Contractor shall be responsible for providing a 1RU drawer.
- D. Label each equipment with the date (month/year) that it was installed along with the IP address, if applicable, and equipment type.

### 3.5 CYBER SECURITY

- A. Contractor shall change all default username and passwords for all network devices provided. A Strong Password should include at a minimum the following:
  - 1. Be at least 12 characters in length
  - 2. Contain both upper and lowercase alphabetic characters (e.g. A-Z, a-z)
  - 3. Have at least one numerical character (e.g. 0-9)
  - 4. Have at least one special character (e.g. ~!@#\$\$%^&\*()\_-=)
  - 5. Cannot contain full words
- B. No written username or passwords shall be located in any areas of installation.
- C. Network devices to be set up on a separate network other than owner's LAN ensuring no internal or external users can access system without authorization.
- D. Follow manufacturers hardening guide and use best industry practices to secure network and devices provided by contractor and associated with system.

### 3.6 FIELD QUALITY CONTROL

- A. Manufacturer's Field Services:
  - 1. Provide services of a duly factory authorized service representative for this project location to supervise the field assembly and connection of components and the pre-testing, testing, and adjustment of the system.
- B. Inspection:
  - 1. Make observations to verify that units and controls are properly labeled, and interconnecting wires and terminals are identified. Provide a list of final tap settings of paging speaker line matching transformers.
  - 2. The installation technician from the installer / manufacturer shall perform all system tests as specified. Perform all tests in the presence of the Owner, Architect / Engineer and any designated personnel as deemed necessary by the Owner or Architect / Engineer. This test shall be performed with the devices at their operational location and under normal operational conditions. Bench or default settings for devices are not acceptable. All test and test report costs shall be included in the contractors bid. A checkout report shall be generated by the installation technician and submitted to the Owner and Architect. The report shall include but not be limited to the following:
    - a. A complete list of all equipment installed with corresponding serial numbers.
    - b. Indication that all equipment is properly installed, functions and conforms to the specifications.

- c. Serial numbers, locations by device and model number for each installed device.
- d. Technician's name, specified certification credentials and date of system test.
- e. Any additional information as deemed necessary by the Owner and or Architect / Engineer.

C. TESTING:

1. Upon completion of installation of each system and after electrical circuitry has been energized, demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units on site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with testing.
2. Before inspection by owner and AV Consultant, and after completion of the installation, conduct system tests and make necessary corrections for proper system operation.
3. Adjust, balance and align equipment for optimum quality and to meet the manufacturer's published specifications.
4. All limiters and/or compressors shall be set to prevent operators from over-adjusting sound levels and damaging system components.
5. System shall have no audible hum, noise, RFI, or distortion when operating under normal conditions. System shall reproduce material at the loudspeakers rated output level without audible distortion. All input levels shall be pre-set so system may be operated without causing unstable feedback under normal use.
6. System shall have no image distortion, hum bars, color shift, or any other picture distortion while operating under normal conditions. Provide cable equalizers, located near displays, on all cables that are more than 30 feet in length and/or have more than 4 connection points.
7. Adjust gain controls for optimum signal-to-noise with 0 dBu at a line-level input.
8. Perform polarity checks of loudspeaker lines by means of a polarity tester or use DC source at one end of each line and a voltmeter at the other end. Loudspeaker lines shall be identically polarized with respect to color coding.
9. Loose parts and poor workmanship or soldering shall be replaced.
10. Sweep Loudspeaker systems with high-level sine wave or 1/3 octave pink noise source. Correct causes of buzzes or rattles related to Loudspeakers or enclosures. Notify owner of external causes of buzzes or rattles.
11. Contractor shall provide system testing as described herein using up-to-date and industry accepted test equipment appropriate to the types of links being tested and in accordance with the latest edition of IEC 61935-1.
12. Horizontal cabling contractor shall test all twisted pair cabling used within the system following the standards in specification 27 1500 under the testing section. Provide documentation of testing to Intercom Consultant prior to final walk through.

- D. At the time of final commissioning, if the Intercom consultant determines that the systems are not sufficiently complete to do a final punch list, and was not notified at least three (3) days prior to the visit, then a return visit will be required. The Intercom Consultant's return visit will be paid for in advance by the Intercom integrator at a flat

rate of \$500 per person, at no cost to the owner.

3.7 OCCUPANCY ADJUSTMENTS:

- A. When requested by the Architect within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, and adjusting controls to suit actual occupied conditions.

3.8 TRAINING

- A. The contractor shall provide and implement a complete and comprehensive staff training program for all administrators, facility staff members and teachers. This mandatory training program will provide school staff a complete understanding of how to utilize and properly operate all functions.
- B. The training program shall be implemented by a staff member/trainer employed by the contractor. The trainer must be factory certified to provide training on their product.
- C. All staff development training is to be coordinated through the owner's designated representative. As training sessions are completed, the trainer will provide the school's administrative staff and school district's staff a document listing all of the staff and faculty members who attended, received and completed the training program.
- D. Provide a minimum of one (1), one (1) hour sessions of in-service training with this system. These sessions shall be broken into segments that will facilitate the training of individuals in the operation of this system. Operators Manuals and Users Guides shall be provided at the time of this training.
- E. Schedule training with Owner through the Architect, with at least fourteen (14) days advance notice.
- F. Training shall be recorded using a video recording device that support a minimum resolution of 1080P/60 with an integrated microphone connection for an external microphone and a camera tri-pod mount. Presenter shall be wearing a lapel microphone that connects to the recording device and a Tri-pod shall be used for stabilizing the recording device. Recordings that are shaky, poor audio and/or video quality, incomplete, or other issues will not be accepted and the contractor will be responsible for providing a new recording and training within five (5) business days of notification. Provide a digital copy to the Owner and Intercom Consultant. If Digital copy is sent in a link, verification of end user download shall be provided to the owner and Intercom Consultant showing IP address or user that download and what date. The link cannot have an expiration date and will be the responsibility of the contractor to maintain. Links shall be included in the Operating and Maintenance manuals in the first section. Video files shall also be provided on a flash drive within the intercom equipment rack adjacent to the server location. Flash drive shall be clearly labeled.

3.9 CLEANING AND PROTECTION

- A. Prior to final acceptance, the contractor shall vacuum and clean all system components and protect them from damage and deterioration. All general areas within and around all equipment rack/cabinets in the facility will be swept, vacuumed, and cleaned up.



3.10 OPERATING AND MAINTENANCE MANUALS: Refer to Section 26 0502 for requirements.

3.11 RECORD DRAWINGS: Refer to Section 26 0502 for requirements.

END OF SECTION 27 5123

## SECTION 28 3111 - FIRE ALARM AND DETECTION SYSTEM

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS:

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Division-26 Basic Materials and Methods sections apply to work specified in this section.

#### 1.2 DESCRIPTION OF WORK:

- A. Provide new addressable fire alarm devices as required to expand the existing fire alarm system as required.
- B. Install all new wiring in steel conduit (3/4" minimum). All conduit runs shall form a complete loop from the fire alarm control panel.
- C. Comply with NEC as applicable to construction and installation of fire alarm and detection system components and accessories. Provide components and systems, which are UL-listed and labeled for fire alarm. Provide fire alarm and detection systems and accessories, which are FM approved. Comply with State and local requirements as applicable. Provide wiring of horn/strobe units such that the horn section and the strobe section are controlled separately. Provide the ability to silence the horns and maintain the operation of the strobes.
- D. Comply with applicable provisions of current NFPA Standards 72 National Fire Alarm Code (as applicable), local building codes, and meet requirements of local authorities having jurisdiction.

#### 1.3 SUBMITTALS:

- A. PRODUCT DATA: Submit manufacturer's data on fire alarm and detection systems including, but not limited to, roughing-in diagrams and instructions for installation, operating and maintenance, suitable for inclusion in maintenance manuals.
- B. SHOP DRAWINGS: Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm and detection system. Include wiring diagrams and riser diagrams of panel. Provide dimensioned drawing of Fire Alarm Control Panel and Building Graphic.
- C. CERTIFICATION: Submit a written statement to the Architect and the state and local Fire Marshal's Office that each device of the fire alarm system will be installed, inspected and tested in accordance with applicable requirements of NFPA Standard 72.
- D. Provide to the Fire Marshall's office the following:
  - 1. A complete set of shop drawings indicating:

- a. Location of all alarm-initiating and alarm-signaling devices.
  - b. Point-to-point wiring diagrams for all alarm-initiating and alarm-signaling devices.
- 2. Wiring diagrams for:
  - a. Alarm control panels.
  - b. Auxiliary function relays and solenoids.
  - c. Remote signaling equipment.
  - d. Standby battery calculations, including voltage drop calculation.
- 3. A complete equipment list identifying:
  - a. Type
  - b. Model
  - c. Manufacturer
  - d. Manufacturer catalog data sheets
  - e. UL Listing and/or FM approval showing compatibility of device with Fire Alarm Control Panel (FACP)
- 4. A complete zone list identifying all:
  - a. Alarm-initiating and alarm-signaling devices.
  - b. Remote signaling and auxiliary function zones.
  - c. Specific devices associated with each zone.
- E. Submit to State and Local Fire Marshall, a complete Certificate of Compliance

## PART 2 - PRODUCTS

### 2.1 ACCEPTABLE MANUFACTURERS:

- A. MANUFACTURER: Subject to compliance with requirements, provide fire alarm and detection systems of one of the following:
  - 1. The existing system is FCI Gamewell. Contact Nelson Fire Systems for requirements of the system. Fire alarm supplier shall be Gamewell-FCI Platinum Level Distributor.

### 2.2 FIRE ALARM AND DETECTION SYSTEMS:

- A. GENERAL: Add to and maintain the existing electrically operated, electrically supervised fire alarm system as required. Include control units, power supplies, alarm initiating and indicating devices, conduit, wire, fittings and accessories required to provide maintain the operating system. Enclose entire system in raceway. Provide basic wiring materials which comply with Division 26, Basic Materials and Methods Sections for raceways, conductors, boxes, fittings, supports, etc. Minimum wire size to be #14 AWG copper.
- B. SYSTEM TYPE: Analog addressable, non-coded. Either manual activation of a fire alarm station or activation of an automatic initiating device energizes all fire alarm

signaling devices, sounding a non-coded alarm and providing device identification on an annunciator panel.

- C. SYSTEM OPERATION: Add to the system as required such that any manual station or automatic initiating device annunciates all alarm indicating units (bells, horns, buzzers, chimes, visual alarm lamps, etc.) continuously until the manual station or initiating device is restored to normal and the fire alarm control unit reset. Annunciate alarm signals by device at the control panel and all remote annunciators. Provide all conductors, raceway, equipment and labor to accomplish the following:
- D. For fans which are not part of the smoke evacuation system, deactivate air supply and return fan units simultaneously by means of a supervised master fan shutdown relay with slave relays as required. Restart air units automatically after panel has been reset. Provide a bypass switch for master fan shut down relay for drill purposes, and indicate by a locked-in lamp that the circuit has been bypassed.
- E. Selectively activate and/or deactivate fan units as required.
- F. Release all magnetic door holders upon activation of an alarm from any device by use of a master relay in the control panel.
- G. Provide supervised circuits for the following:
  - 1. Close dampers upon activation of an alarm from any device through the HVAC interface relays at the Fire Command Center.
  - 2. Recall elevators, upon activation of an alarm, to the floor of building egress unless the alarm is on the egress floor, in which case recall elevator to the level designated by the Fire Marshall. Cooperate with the elevator supplier to ensure complete operable system. Provide shunt trip breaker(s) as required.
- H. Central Station Monitoring. Provide a UL listed fire control communicator in accordance with NFPA 71 with a minimum of two reporting zones to the central station. Provide a communicator with dual phone lines for central station reporting by using Contact I.D. format. Provide integral trouble annunciator. Provide with compatibility for automatic test reports every 24 hours. Provide system and components which comply with UL 2635 and UL 864.
- I. Provide fire alarm control panel with capability of shutting down individual initiating devices for maintenance purposes without affecting the continued operation of other initiating devices.

## 2.3 MONITOR MODULE:

- A. Remote identification module devices shall be attached to any single normally open initiating device (heat detector, waterflow switch, duct detectors, sprinkler, tamper switches, kitchen hood, pull station, etc.). The modules shall supply addressing and status information to the Fire Alarm Control Panel through the dual loop module.

## 2.4 CONTROL POINT MODULE:

- A. The control point module shall be connected to the same loop as the initiating devices, and shall provide a relay output (Form "C" 2 Amp @ 24 VDC, resistive only).
- B. This relay output shall be used to perform auxiliary functions.
- C. When the AOM is activated, the red "ACTIVE" LED shall be on solid. Under normal conditions, the red "ON LINE" LED shall flash.

2.5 IONIZATION SMOKE DETECTORS):

- A. All ionization smoke detectors shall be capable of being replaced without disconnecting any wires or wire connectors from the base of the detector. Each detector shall be installed on a separate base. The detector base shall be capable of receiving a photoelectric, ionization, or electronic thermal detector. All ionization fire detectors shall be UL 268 listed. All detectors shall have (2) viewable LEDs to indicate the status of the device.

2.6 DUCT FIRE DETECTORS:

- A. Provide ionization type with UL 268A listings. Each detector shall be equipped with a remote light. Each detector shall have (2) form "c" alarm contacts rated at 10 amps (at 120VAC).

2.7 THERMAL DETECTOR:

- A. Thermal detectors shall operate on the Rate-of-Rise principal. The detectors shall have a fixed temperature rating of 135 degrees Fahrenheit. Exception: in Boiler rooms, provide temperature rating of 200 degrees Fahrenheit.
  - 1. The heat detector shall consist of a base and a head.
  - 2. The base shall be capable of accepting either a smoke detector or a 135 (or 200) degree heat detector.
  - 3. The head shall automatically restore to its normal standby condition when the temperature returns to its normal range.

2.8 AUDIOVISUAL ALARM HORNS:

- A. Provide audio-visual alarm horns with selectable multi-candela strobes (15/30/75/110 cd) and selectable horn ( 90 or 95 dba). Provide outdoor devices listed for exterior use. Provide white devices inside and red devices outside, or as instructed by the architect.
- B. All strobes shall be synchronized.

2.9 VISUAL ALARM STROBES:

- A. Provide visual alarm strobes with selectable multi-candela strobes (15/30/75/110 cd). Provide white devices.

- B. All strobes shall be synchronized.

2.10 CARBON MONOXIDE (CO) DETECTOR (EST SIGA2-COS):

- A. Provide a carbon monoxide detector. Provide detectors with the following features:
  - 1. Compliance with UL2075.
  - 2. Trouble relay.
  - 3. Wiring supervision with SEMS Terminals.
  - 4. A six year end-of-life timer.
  - 5. Sounder base for sound audible alarm.

2.11 VISUAL ALRM STROBES (BLUE):

- A. Provide a visual alarm strobe with blue light for CO notification.

2.12 AUXILIARY RELAY:

- A. Remote auxiliary relay boards shall be rated at 10 AMPS @ 120 VAC. A red LED shall light to indicate relay activation. All relays shall transfer on general alarm and latch on until reset. All relays shall be supervised. The control output provided can be used in conjunction with fire alarm applications (i.e. fan controls, dampers, doors, and any other general alarm control).

2.13 INITIATING MODULES:

- A. Provide style "6" initiating modules capable of receiving and annunciating an alarm from any detector, even with a single fault condition on any initiating circuit.
- B. Power all smoke detectors from the "Style 6" initiating loop wiring. For systems which power smoke detectors separately from the "Style 6" loop, provide monitoring for both the power source and the independent initiating wiring, so that complete trouble and alarm indication is achieved by loop. Provide capability to operate all smoke detectors, even with a single fault condition on the smoke detector power wiring. Provide one spare initiating circuit.

2.14 SIGNALING MODULES:

- A. Provide signaling as required. Provide power adequate to sound all signaling devices concurrently. Provide supervised indicating circuits for polarized 24V D.C. alarm signaling devices. Provide 2 spare signaling circuits.
- B. Each signal circuit shall have a separate disconnect switch for servicing the fire alarm system. Each and every indicating circuit shall have a distinct location description. Power supply shall be at fire alarm control panel. Remote power supplies and indicating circuits will not be acceptable.

2.15 SUPPLEMENTAL NOTIFICATION CIRCUITS:

- A. Provide supplementary notification appliance circuit panel(s) as required. The 'PANELS' shall be capable of supplying up to four Class A, Style Z notification appliance circuits. The panel shall contain its own battery charger, regulated power supply, and shall be supervised for ground fault, overcurrent, open circuits and low battery conditions. Ground fault, battery and circuit trouble conditions shall transmit a trouble signal to the main fire alarm control panel.

#### 2.16 SYSTEM CONFIGURATION PROGRAMMING:

- A. Update system programming as a result of the remodel. To help the owner in programming, system changes, and servicing, the fire alarm system shall have the following functions:
  - 1. The FACP shall be capable of an auto-configuration, which, via a password, all analog devices and panel modules are automatically programmed into the system. At this point the system will operate as a general alarm system without any other programming.
  - 2. If any two devices are addressed the same, the LED's on both devices will light steady and the panel will read "extra address with the address number".
  - 3. If any device is installed and not programmed into the system, the LED will light steady and the panel will read the same as above.

#### 2.17 BATTERIES/POWER SUPPLIES:

- A. Provide standby batteries capable of operating fire alarm system for minimum of 24 hours, then operating all indicating units for at least five minutes. Locate batteries in fire alarm control unit, or in similar type enclosure located as directed. Provide all interconnecting wiring. Place batteries which vent hydrogen gas in separate enclosure. Provide 30 percent spare capacity.

### PART 3 - EXECUTION

#### 3.1 GENERAL REQUIREMENTS:

- A. Install fire alarm and detection devices as indicated, in accordance with equipment manufacturer's written instructions and complying with applicable portions of NEC and NECA's "standard of installation".
- B. Wire each CO detector to deactivate the HVAC fan unit feeding the zone served by the detector to shut down the fan when CO levels exceed the allowable levels set by the Utah State Fire Marshal.
- C. Review proper installation procedure for each type of device with equipment supplier before installation.

- D. Where surface installation is required, it must be approved by the architect. Use wiremold as approved in each application

3.2 GUARANTEE:

- A. Furnish a three-year guarantee for all equipment, materials and installation, including all labor, transportation, and equipment.
- B. Emergency Response. The fire alarm equipment supplier shall provide an emergency response within four hours of any reported system failure to resolve the problem on a continuous basis.

3.3 PRE-TEST:

- A. The contractor shall with a representative of the manufacturer conduct a test 3 days before the final test to verify operation of all devices, new and existing. Any problems must be corrected before the final test.

3.4 FINAL TEST:

- A. Before the installation shall be considered completed and acceptable, a test on the system shall be performed as follows:
  - 1. The contractor's job foreman, a representative of the manufacturer, a representative of the owner, shall operate every building fire alarm device to ensure proper operation and correct annunciation at the control panel. Fan shutdown and door holder circuits shall operate.
  - 2. Conduct a full 24 hour test of battery operation. System shall be put on the batteries for a full 24 hours and all notification appliances shall be operational for a period of 5 minutes.
  - 3. The supervisory circuitry of the initiating and indicating circuits shall also be verified.
  - 4. Provide printout demonstrating successful performance of all devices.
  - 5. Re-certify the system as compliant with State regulations.

3.5 LABELING:

- A. All devices shall be labeled with their appropriate address. The labels shall be 18 point pressure sensitive labels.
- B. All initiating devices shall be programmed to include the device address and a complete user text English location description, i.e. Device L4S76, Smoke Detector, 1st floor Rm.17.
- C. Label the end of all wires in all boxes including panels, power supplies, pull boxes, etc.

3.6 RECORD DRAWINGS



- A. Update existing recording drawings and building map. The building map shall indicate the various devices and wiring by the use of different colors (minimum of five colors).

3.7 OPERATING AND MAINTENANCE MANUALS:

- A. Operating and maintenance manuals shall be submitted prior to testing of the system. Manuals shall include all service, installation, and programming information.

END OF SECTION 26 3111