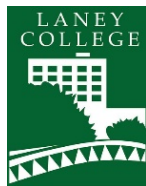




PERALTA COMMUNITY COLLEGE DISTRICT

Laney College Title IX Locker Room Remodel Criteria Documentation Specifications

PREPARED FOR:



PREPARED BY:



550 Montgomery Street, Suite 925
San Francisco, CA 94111

Architect's Project Number: 5514
Prepared on: April 3, 2020
Update for Design Build RFP: **August 10, 2020**

SPECIFICATIONS

2.01 DIVISION 02 -- EXISTING CONDITIONS

- A. 02 41 00 - Demolition

2.02 DIVISION 03 -- CONCRETE

- A. 03 20 00 - Concrete Reinforcing
- B. 03 30 00 - Cast-in-Place Concrete

2.03 DIVISION 05 -- METALS

- A. 05 40 00 - Cold-Formed Metal Framing
- B. 05 52 13 - Pipe and Tube Railings

2.04 DIVISION 06 -- WOOD, PLASTICS, AND COMPOSITES

- A. 06 10 00 - Rough Carpentry
- B. 06 41 00 - Architectural Wood Casework

2.05 DIVISION 07 -- THERMAL AND MOISTURE PROTECTION

- A. 07 21 00 - Thermal Insulation
- B. 07 84 00 - Firestopping
- C. 07 92 00 - Joint Sealants

2.06 DIVISION 08 -- OPENINGS

- A. 08 11 13 - Hollow Metal Doors and Frames
- B. 08 31 00 - Access Doors and Panels
- C. 08 33 13 - Coiling Counter Doors
- D. 08 43 13 - Aluminum-Framed Storefronts
- E. 08 80 00 - Glazing
- F. 08 83 00 - Mirrors

2.07 DIVISION 09 -- FINISHES

- A. 09 05 61 - Common Work Results for Flooring Preparation
- B. 09 21 16 - Gypsum Board Assemblies
- C. 09 30 00 - Tiling
- D. 09 51 00 - Acoustical Ceilings
- E. 09 65 00 - Resilient Flooring
- F. 09 68 13 - Tile Carpeting
- G. 09 91 23 - Interior Painting

2.08 DIVISION 10 -- SPECIALTIES

- A. 10 11 00 - Visual Display Units
- B. 10 14 00 - Signage
- C. 10 21 13.17 - Phenolic Toilet Compartments
- D. 10 26 00 - Wall and Door Protection

- E. 10 28 00 - Toilet, Bath, and Laundry Accessories
- F. 10 44 00 - Fire Protection Specialties
- G. 10 51 00 - Lockers

2.09 DIVISION 12 -- FURNISHINGS

- A. 12 24 00 - Window Shades - MechoShade Systems
- B. 12 36 00 - Countertops

2.10 DIVISION 21 -- FIRE SUPPRESSION

- A. 21 00 00 - Fire Suppression Basic Requirements
- B. 21 05 00 - Common Work Results for Fire Suppression
- C. 21 13 00 - Fire-Suppression Sprinkler Systems

2.11 DIVISION 22 -- PLUMBING

- A. 22 00 00 - Plumbing Basic Requirements
- B. 22 05 19 - Plumbing Devices
- C. 22 05 23 - General-Duty Valves for Plumbing Piping
- D. 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
- E. 22 05 48 - Vibration and Seismic Controls for Plumbing Piping and Equipment
- F. 22 05 53 - Identification for Plumbing Piping and Equipment
- G. 22 05 93 - Testing, Adjusting, and Balancing for Plumbing
- H. 22 07 00 - Plumbing Insulation
- I. 22 10 00 - Plumbing Piping
- J. 22 30 00 - Plumbing Equipment
- K. 22 40 00 - Plumbing Fixtures

2.12 DIVISION 23 -- HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

- A. 23 00 00 - Heating, Ventilating, and Air Conditioning (HVAC) Basic Requirements
- B. 23 05 13 - Common Motor Requirements for HVAC Equipment
- C. 23 05 19 - Meters and Gauges for HVAC Piping
- D. 23 05 23 - General-Duty Valves for HVAC Piping
- E. 23 05 29 - Hangers and Supports for HVAC Piping and Equipment
- F. 23 05 48 - Vibration and Seismic Controls for HVAC
- G. 23 05 53 - Identification for HVAC Piping and Equipment
- H. 23 05 93 - Testing, Adjusting, and Balancing for HVAC
- I. 23 07 00 - HVAC Insulation
- J. 23 09 00 - Instrumentation and Control Performance Specifications
- K. 23 21 13 - HVAC Piping
- L. 23 21 16 - Hydronic Piping Specialties
- M. 23 31 00 - HVAC Ducts and Casings
- N. 23 33 00 - Air Duct Accessories
- O. 23 34 00 - HVAC Fans
- P. 23 36 00 - Air Terminal Units
- Q. 23 37 00 - Air Outlets and Inlets
- R. 23 40 00 - HVAC Air Cleaning Devices

S. 23 82 16 - Air Coils

2.13 DIVISION 26 -- ELECTRICAL

- A. 26 05 05 - Selective Demolition for Electrical
- B. 26 05 19 - Low-Voltage Electrical Power Conductors and Cables
- C. 26 05 26 - Grounding and Bonding for Electrical Systems
- D. 26 05 29 - Hangers and Supports for Electrical Systems
- E. 26 05 33 - Raceways and Boxes for Electrical Systems
- F. 26 05 53 - Identification for Electrical Systems
- G. 26 05 83 - Wiring Connections
- H. 26 09 23 - Automatic Lighting Control Devices
- I. 26 24 16 - Panelboards
- J. 26 27 26 - Wiring Devices
- K. 26 51 00 - Interior Lighting

**SECTION 02 41 00
DEMOLITION**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Selective demolition of building elements for alteration purposes.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- B. Section 01 10 00 - Summary: Sequencing and staging requirements.
- C. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- D. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- E. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- F. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - U.S. Occupational Safety and Health Standards; current edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.

PART 3 EXECUTION

2.01 SCOPE

- A. Remove portions of existing buildings as indicated on drawings.
- B. Remove paving and curbs as required to accomplish new work associated with accessible path of travel to area of alteration.
- C. Remove portion of concrete slabs on grade as indicated on drawings.
- D. Remove other items indicated, for salvage and relocation.

2.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

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

- C. Do not begin removal until built elements to be salvaged or relocated have been removed.
- D. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop work immediately if adjacent structures appear to be in danger.
- E. If hazardous materials are discovered during removal operations, stop work and notify Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

2.03 EXISTING UTILITIES

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

2.04 SELECTIVE DEMOLITION FOR ALTERATIONS

- A. Drawings showing existing construction and utilities are based on casual field observation and existing record documents only.
 - 1. Verify that construction and utility arrangements are as indicated.
 - 2. Report discrepancies to Owner before disturbing existing installation.
 - 3. Beginning of demolition work constitutes acceptance of existing conditions that would be apparent upon examination prior to starting demolition.
- B. Remove existing work as indicated and as required to accomplish new work.
 - 1. Remove rotted wood, corroded metals, and deteriorated masonry and concrete; replace with new construction specified.
 - 2. Remove items indicated on drawings.
- C. Services (Including but not limited to HVAC, Plumbing, Fire Protection, Electrical, and Telecommunications): Remove existing systems and equipment as indicated.
 - 1. Maintain existing active systems that are to remain in operation; maintain access to equipment and operational components.
 - 2. Where existing active systems serve occupied facilities but are to be replaced with new services, maintain existing systems in service until new systems are complete and ready for service.
 - 3. Verify that abandoned services serve only abandoned facilities before removal.
 - 4. Remove abandoned pipe, ducts, conduits, and equipment, including those above accessible ceilings; remove back to source of supply where possible, otherwise cap stub and tag with identification.

- D. Protect existing work to remain.
 - 1. Prevent movement of structure; provide shoring and bracing if necessary.
 - 2. Perform cutting to accomplish removals neatly and as specified for cutting new work.
 - 3. Repair adjacent construction and finishes damaged during removal work.
 - 4. Patch as specified for patching new work.

2.05 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 20 00

CONCRETE REINFORCEMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 RELATED REQUIREMENTS

- B. Section 03 30 00 - Cast-in-Place Concrete.

1.03 REFERENCE STANDARDS

- A. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2016.
- B. ACI 318 - Building Code Requirements For Structural Concrete and Commentary; American Concrete Institute International; 2014.
- C. ACI SP-66 - ACI Detailing Manual; American Concrete Institute International; 2004.
- D. ASTM A 615/A 615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement; 2012.
- E. ASTM A 706/A 706M - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement; 2009b.
- F. AWS D1.4/D1.4M - Structural Welding Code - Reinforcing Steel; American Welding Society; 2011.
- G. CRSI (DA4) - Manual of Standard Practice; Concrete Reinforcing Steel Institute; 2009.
- H. CRSI (P1) - Placing Reinforcing Bars; Concrete Reinforcing Steel Institute; Ninth Edition.
- I. 2019 CBC – 2019 California Building Code

1.04 SUBMITTALS

- A. Manufacturer's Certificate: Certify that reinforcing steel and accessories supplied for this project meet or exceed specified requirements.
- B. Product Data: Submit for bar supports, chairs, rebar couplers, and flat slab shear reinforcing.
- C. Reports: Submit paper and PDF digital certified copies of mill test report of reinforcement materials analysis.
- D. Indicate on any and all submittal documents the Owner's project number.

1.05 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Store reinforcement in a manner that will prevent rusting or coating with grease, oil, dirt, and other objectionable materials.
- B. Deliver reinforcement to the job site bundled, tagged and marked, using metal tags.

1.06 QUALITY ASSURANCE

- A. Perform work of this section in accordance with CRSI (DA4), CRSI (P1), ACI 301, ACI SP-66, and ACI 318 in addition to applicable building code.

PART 2 PRODUCTS

2.01 REINFORCEMENT

- A. Reinforcing Steel: ASTM A 615/A 615M Grade 60 (420) for #7 and smaller bars.
 - 1. Deformed billet-steel bars.
 - 2. Unfinished.
- B. Reinforcing Steel: ASTM A 706/A 706M, Grade 60 (420) for #8 and larger bars and all bars to be welded. Permitted for bars #7 and smaller.
 - 1. Deformed low-alloy steel bars
 - 2. Unfinished.

2.02 REINFORCEMENT ACCESSORIES:

- A. Tie Wire: Annealed, minimum 16 gage (1.5 mm).
- B. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.

2.03 FABRICATION

- A. Fabricate concrete reinforcing in accordance with CRSI (DA4) - Manual of Standard Practice, ACI SP-66 - ACI Detailing Manual, ACI 318, and ACI 301.
- B. Locate reinforcing splices not indicated on drawings at point of minimum stress.
 - 1. Stagger splice locations so that no more than 50% of the bars are spliced at a section.
 - 2. Locations of splices subject to approval by Owner's Representative.

2.04 SOURCE QUALITY CONTROL

- A. An independent testing agency will perform source quality control review, as specified in Section 01 45 00 - Quality Control.
- B. Review and submit on paper and digital PDFs all mill test reports.

PART 3 EXECUTION

3.01 PLACEMENT

- A. Place, support and secure reinforcement against displacement. Do not deviate from required position by more than the tolerances set forth in ACI 301.
- B. Do not displace or damage vapor barrier and water proofing membrane.
- C. Accommodate placement of formed openings.
- D. Maintain concrete cover around reinforcing as indicated on drawings.
- E. Conform to applicable code for concrete cover over reinforcement.
- F. Clean reinforcement of loose rust and mill scale, oil, grease, earth, ice, and other materials which reduce or destroy bond with concrete.

- G. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- H. Do not bend or realign reinforcement after being embedded in hardened concrete.

3.02 FIELD QUALITY CONTROL

- A. An independent testing agency will perform source quality control review, as specified in Section 01 45 00 - Quality Control.
- B. Inspect placement, location, splices, spacing, size, cover and type of reinforcement for conformance with the contract documents.

END OF SECTION

SECTION 03 30 00

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Miscellaneous concrete elements, including equipment pads and curbs.
- B. Concrete curing.

1.02 RELATED REQUIREMENTS

- B. Section 03 20 00- Concrete Reinforcement.

1.03 REFERENCE STANDARDS

- A. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2009).
- B. ACI 301 - Specifications for Structural Concrete for Buildings; American Concrete Institute International; 2016.
- C. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2015.
- D. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000 (Reapproved 2009).
- E. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2016
- F. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2014.
- G. ASTM C 31 - Standard Method of Making and Curing Concrete Test Specimens in the Field. 2012
- H. ASTM C 33 - Standard Specification for Concrete Aggregates; 2013.
- I. ASTM C 39/C 39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2005.
- J. ASTM C 94/C 94M - Standard Specification for Ready-Mixed Concrete; 2014A.
- K. ASTM C 143/C 143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2015a.
- L. ASTM C 150 - Standard Specification for Portland Cement; 2012.
- M. ASTM C 171 - Standard Specification for Sheet Materials for Curing Concrete; 2016.
- N. ASTM C 173/C 173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2016.
- O. ASTM C 260 - Standard Specification for Air-Entraining Admixtures for Concrete; 2016.
- P. ASTM C 309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- Q. ASTM C 494/C 494M - Standard Specification for Chemical Admixtures for Concrete; 2017.
- R. ASTM C 618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012a.

- S. ASTM C 1107/C 1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2017.
- T. ASTM C 1240 - Standard Specification for Silica Fume Used in Cementitious Mixtures; 2015.
- U. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- V. 2019 CBC – 2019 California Building Code

1.04 SUBMITTALS

- A. See Section 01 33 00 – Submittal Procedures, for submittal procedures.
- B. Product Data: Submit manufacturer's data on manufactured products.
- C. Samples: Submit as required by Owner's Representative.
- D. Certified mix design: Submit for each type and strength of concrete, at least 4 weeks prior to placement.
 - 1. Include results of testing or test data used to establish mix proportions. This is to include unit weight, slump, shrinkage, and compression test reports. Mix designs to be prepared, stamped and signed by a Professional Engineer registered in the State of California.
- F. Certificates of Compliance:
 - 1. Cement.
 - 2. Aggregates.
 - 3. Admixtures.
 - 4. Color Pigments.
- G. Proposed construction joint locations.
- H. Manufacturer's Installation Instructions: Indicate installation procedures and interface required with adjacent construction for concrete accessories.
- I. Indicate on any and all submittal documents the Owner's project number.

1.05 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
 - 1. Maintain one copy of each document on site.
- B. Qualifications:
 - 1. A firm experienced in manufacturing ready mixed concrete products complying with ASTM C 94 and requirements for production facilities and equipment.
 - 2. Certified according to the National Ready Mixed Concrete Association certification for ready mixed concrete production facilities.

PART 2 PRODUCTS

2.01 REINFORCEMENT

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

2.02 CONCRETE MATERIALS

- A. Cement: ASTM C 150, Type I - Normal or Type II - Moderate Portland type.
 - 1. Acquire all cement for entire project from same source.

- B. Fine and Coarse Aggregates: ASTM C 33. Cleanliness not to be less than 75 when tested in accordance with California Test 217 for Fine Aggregates or California Test 227 for Coarse Aggregates.
 - 1. Acquire all aggregates for entire project from same source.
- C. Fly Ash: ASTM C 618, Class F.
- D. Calcined Pozzolan: ASTM C 618, Class N.
- E. Silica Fume: ASTM C 1240, proportioned in accordance with ACI 211.1.
- F. Water: Clean and not detrimental to concrete.

2.03 CHEMICAL ADMIXTURES

- A. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- B. Admixtures to be compatible with all other components in the mix.
- C. Admixtures are to be included in the mix used to establish the mix design.
- D. Air Entrainment Admixture: ASTM C 260.
- E. High Range Water Reducing and Retarding Admixture: ASTM C 494/C 494M Type G.
- F. High Range Water Reducing Admixture: ASTM C 494/C 494M Type F.
- G. Water Reducing and Accelerating Admixture: ASTM C 494/C 494M Type E.
- H. Water Reducing and Retarding Admixture: ASTM C 494/C 494M Type D.
- I. Accelerating Admixture: ASTM C 494/C 494M Type C.
- J. Retarding Admixture: ASTM C 494/C 494M Type B.
- K. Water Reducing Admixture: ASTM C 494/C 494M Type A.
- L. Shrinkage Reducing Admixture: ASTM C 494/C 494M, ASTM C 157
 - 1. Manufacturers:
 - a. Eclipse; Grace Construction Products: www.na.graceconstruction.com, or Equal
 - c. Substitutions: See Section 01 62 00 - Product Options and Substitutions.

2.04 ACCESSORY MATERIALS

- A. Chemical Hardener: Fluosilicate solution designed for densification of cured concrete slabs.
- B. Non-Shrink Grout: ASTM C 1107 Grade B.
- C. Moisture-Retaining Cover: ASTM C 171; white burlap-polyethylene sheet.
- D. Liquid Curing Compound: ASTM C 309, Type 1, clear or translucent.

2.05 BONDING AND JOINTING PRODUCTS

- A. Joint Filler: Nonextruding, resilient asphalt impregnated fiberboard, felt, or cork, complying with ASTM D 1751, 1/4 inch (6 mm) thick and 4 inches (200 mm) deep unless otherwise indicated; tongue and groove profile.

2.06 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations and ACI 318,

Section 5.3 requirements.

1. Use admixtures as necessary to produce concrete of a consistency that will allow thorough compaction of the concrete into corners and around reinforcing without excessive puddling, spading or vibration, and without permitting the materials to segregate or free water to collect on the surface. Produce dense and uniform concrete free from rock pockets, honeycomb and other irregularities.
 2. Contractor to review and approve the proposed concrete mix designs for compatibility with placing requirements to ensure that the concrete as designed can be placed in accordance with the Drawings and Specifications.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience, as specified in ACI 301. Mix design to be prepared by a licensed Professional Engineer.
- C. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended by manufacturer.
- D. Cements and aggregates to have a proven history of successful use together. Alternatively submit evidence satisfactory to Owner's Representative that aggregate will not react harmfully in presence of alkalis in cement.
- E. Normal Weight Concrete:
1. Compressive Strength, when tested in accordance with ASTM C 39/C 39M at 28 days: As indicated on drawings.
 2. Water-Cementitious Materials Ratio: Maximum 45 percent by weight.
 3. Dry Unit Weight: Minimum 144 lbs per cubic foot and maximum of 150 lbs per cubic foot.
 4. Total Air Content: 6 percent maximum, determined in accordance with ASTM C 173/C 173M.
 5. Admixtures: High Range Water Reducer at contractor's option.
 6. Maximum Slump at point of placement: 4 inches (100 mm).
 - a. Maximum Slump With Water Reducing Admixture: 8 inches (200 mm).
 7. Minimum Slump at point of placement: 1 inch (25 mm)
 8. Maximum Aggregate Size: 1 inch (40 mm).
 9. Drying Shrinkage:
 - a. Typical: Maximum 0.050 percent unless otherwise indicated.
- F. Patching Mortar: Mix in proportions by volume of one-part cement to two parts water. Substitute white cement for part of cement as necessary to produce color matching surrounding concrete.

2.07 MIXING

- A. On Project Site: Mix in drum type batch mixer, complying with ASTM C 685. Mix each batch not less than 1-1/2 minutes and not more than 5 minutes.
- B. Transit Mixers: Comply with ASTM C 94/C 94M.

2.08 SOURCE QUALITY CONTROL

- A. An independent testing agency will perform source quality control review, as specified in Section 01 45 00.
- B. Review mix designs and certificates of compliance for materials Contractor proposes to use with Owner's Representative.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Verify that forms are clean and free of rust before applying release agent.
- B. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- C. Roughen surfaces of previously placed and existing concrete to 1/4 inch (7 mm) amplitude by heavy sand-blasting, waterblasting or bush-hammering. Prior to receiving concrete, clean surfaces of dust and debris using compressed air or water.
- D. Clean surfaces of reinforcement and forms previously coated with cementitious materials by wire brushing or other acceptable means.
- E. Thoroughly wet all concrete and wood forms before application of concrete. Do not allow free water to remain on the surface.

3.03 PLACING CONCRETE

- A. Place concrete in accordance with ACI 301.
- B. Place concrete for floor slabs in accordance with ACI 302.1R.
- C. Notify Owner not less than 48 hours prior to commencement of placement operations.
- D. Do not place concrete until testing agency has inspected reinforcing placement.
- E. Water may be added once to each truckload in the field provided the specified water-cement ratio is maintained.
- F. Ensure reinforcement, inserts, embedded parts, and formwork will not be disturbed during concrete placement.
- G. Install joint devices in accordance with manufacturer's instructions.
- H. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- I. Do not interrupt successive placement; do not permit cold joints to occur.
- J. Consolidate concrete in accordance with ACI 309.

3.04 CONCRETE FINISHING

- A. Drypack surface defects, including tie holes, immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch (6 mm) or more in height.
- D. Concealed Concrete Surfaces: Rough Formed
- E. Concrete Slabs: Finish to requirements of ACI 302.1R

3.05 CURING AND PROTECTION

- A. Comply with requirements of ACI 308. Immediately after placement, protect concrete from

premature drying, excessively hot or cold temperatures, and mechanical injury.

- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 - 1. Normal concrete: Not less than 7 days.
- C. Formed Surfaces: Cure by moist curing with forms in place. Provide curing for remainder of curing period after form removal.
- D. Surfaces Not in Contact with Forms:
 - 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water ponding, water-saturated sand, water-fog spray, or saturated burlap.
 - 2. Final Curing: Begin after initial curing but before surface is dry.
 - a. Moisture-Retaining Cover: Seal in place with waterproof tape or adhesive.
 - b. Curing Compound: Apply two coats as recommended by manufacturer.

3.06 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, per Section 01 45 00.
- B. Provide free access to concrete operations at project site and cooperate with appointed firm.
- C. Provide full time special inspection during concrete placement.
- D. Tests of concrete and concrete materials may be performed at any time.
- E. Compressive Strength Tests: ASTM C 39/C 39M. For each test, mold and cure four concrete test cylinders. Obtain test samples no less than one time per day and no less than once for every 50 cu yd (345 cu m) of each class of concrete placed each day. 1 specimen tested at 7 days, 2 specimens tested at 28 days, and one specimen retained in reserve.
- F. Perform one slump test for each set of test cylinders taken, following procedures of ASTM C 143/C 143M.
- G. Concrete Temperature: Test hourly when air temperature is 40F (4C) and below, and when 80F (27C) and above; and each time a set of compression test specimens is made.
- H. Review the ticket of each batch of concrete delivered to the site for conformance.
- I. Verify proper curing procedure and applications at initial curing and final curing stages.

3.07 DEFECTIVE CONCRETE

- A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- B. Where deficiencies are noted, the Contractor to report defective concrete in writing to Owner within 24 hours.
- C. Repair or replacement of defective concrete will be determined by the Owner. The cost of additional testing, repair and design services to be borne by Contractor when defective concrete is identified.
- D. Contractor to submit repair of defective concrete within 2 days of discovery.
- E. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Owner's Representative for each individual area.

END OF SECTION

SECTION 05 40 00
COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Formed steel stud interior wall framing.

1.02 REFERENCE STANDARDS

- A. AISI S100-12 - North American Specification for the Design of Cold-Formed Steel Structural Members; American Iron and Steel Institute; 2012.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- D. ASTM C955 - Standard Specification for Cold-Formed Steel Structural Framing Members; 2018, with Editorial Revision.
- E. ASTM C1007 - Standard Specification for Installation of Load Bearing (Transverse and Axial) Steel Studs and Related Accessories; 2011a (Reapproved 2015).
- F. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2015, with Errata (2016).
- G. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic"); 2002 (Ed. 2004).

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with work of other sections that is to be installed in or adjacent to the metal framing system, including but not limited to structural anchors, cladding anchors, utilities, insulation, and firestopping.

1.04 QUALITY ASSURANCE

- A. Designer Qualifications: Design framing system under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, and with minimum three years of documented experience.
- C. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Framing:
 - 1. CEMCO: www.cemcosteel.com.
 - 2. ClarkDietrich: www.clarkdietrich.com.
 - 3. Jaimes Industries: www.jaimesind.com.
 - 4. SCAFCO Corporation: www.scafco.com.
 - 5. Steel Construction Systems: www.steelconsystems.com.
- B. Framing Connectors and Accessories:
 - 1. Same manufacturer as metal framing.
 - 2. Simpson Strong Tie: www.strongtie.com.

2.02 FRAMING SYSTEM

- A. Provide primary and secondary framing members, bridging, bracing, plates, gussets, clips, fittings, reinforcement, and fastenings as required to provide a complete framing system.
- B. Design Requirements: Provide completed framing system having the following characteristics:

1. Design: Calculate structural characteristics of cold-formed steel framing members according to AISI S100-12.
2. Structural Performance: Design, engineer, fabricate, and erect to withstand specified design loads for project conditions within required limits.
3. Design Loads: In accordance with applicable codes.
4. Able to tolerate movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.
5. Able to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

2.03 FRAMING MATERIALS

- A. Studs and Track: ASTM C955; studs formed to channel, C- or Sigma-shaped with punched web; U-shaped track in matching nominal width and compatible height.
 1. Gage and Depth: As required to meet specified performance levels.
- B. Jamb Studs: Engineered, C-shaped with wide flanges, designed to replace conventional double-stud framing at openings.
- C. Header: Engineered one-member or two-member assembly, with wide flanges, designed to replace conventional box or nested header framing at openings.
 1. Jamb Mounting Clips: Manufacturer's standard.
 2. Cripple Stud Clips: Manufacturer's standard.
- D. Framing Connectors: Factory-made, formed steel sheet.
 1. Material: ASTM A653/A653M SS Grade 33 and 40 (minimum), with G90/Z275 hot dipped galvanized coating for base metal thickness less than 10 gage, 0.1345 inch, and factory punched holes and slots.
 2. Structural Performance: Maintain load and movement capacity required by applicable code, when evaluated in accordance with AISI S100-12.
 3. Movement Connections: Provide mechanical anchorage devices that accommodate movement using slotted holes, shouldered screws or screws and anti-friction or stepped bushings, while maintaining structural performance of framing. Provide movement connections where indicated on drawings.
 4. Fixed Connections: Provide non-movement connections for tie-down to foundation, floor-to-floor tie-down, roof-to-wall tie-down, joist hangers, gusset plates, and stiffeners.
 5. Wall Stud Bridging Connections: Provide mechanical load-transferring devices that accommodate wind load torsion and weak axis buckling induced by axial compression loads. Provide bridging connections as required to meet design requirements.

2.04 FASTENERS

- A. Self-Drilling, Self-Tapping Screws, Bolts, Nuts and Washers: Hot dip galvanized per ASTM A153/A153M.
- B. Anchorage Devices: Powder actuated.
- C. Welding: Comply with AWS D1.1/D1.1M.

2.05 ACCESSORIES

- A. Bracing, Furring, Bridging: Formed sheet steel, thickness determined for conditions encountered; finish to match framing components.
- B. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify field measurements and adjust installation as required.

3.02 INSTALLATION OF STUDS

- A. Install components in accordance with manufacturers' instructions and ASTM C1007 requirements.
- B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners at maximum 24 inches on center. Coordinate installation of sealant with floor and ceiling tracks.
- C. Place studs at 16 inches on center; not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method.
- D. Construct corners using minimum of three studs. Install double studs at wall openings, door and window jambs.
- E. Install intermediate studs above and below openings to align with wall stud spacing.
- F. Attach cross studs to studs for attachment of fixtures anchored to walls.
- G. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.
- H. Touch-up field welds and damaged galvanized surfaces with primer.

END OF SECTION

SECTION 05 52 13
PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall mounted handrails.
- B. Stair railings and guardrails.
- C. Ramp railings and guardrails.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- C. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2018.
- D. ASTM E935 - Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings; 2013, with Editorial Revision.

1.04 QUALITY ASSURANCE

- A. Structural Designer Qualifications: Professional Structural Engineer experienced in design of this work and licensed in the State in which the Project is located, or personnel under direct supervision of such an engineer.
- B. Welder Qualifications: Show certification of welders employed on the Work, verifying AWS qualification within the previous 12 months.
- C. Fabricator Qualifications:
 - 1. A qualified steel fabricator that is certified by the American Institute for Steel Construction (AISC) under AISC 201.
 - 2. A company specializing in manufacturing products specified in this section, with not less than five years of documented experience.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- B. Distributed Loads: Design railing assembly, wall rails, and attachments to resist distributed force of 75 pounds per linear foot applied to the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
- C. Concentrated Loads: Design railing assembly, wall rails, and attachments to resist a concentrated force of 200 pounds applied at any point on the top of the assembly and in any direction, without damage or permanent set. Test in accordance with ASTM E935.
- D. Allow for expansion and contraction of members and building movement without damage to connections or members.
- E. Dimensions: See drawings for configurations and heights.
 - 1. Top Rails and Wall Rails: 1-1/2 inches diameter, round.
 - 2. Intermediate Rails: 1-1/2 inches diameter, round.

3. Posts: 1-1/2 inches diameter, round.
- F. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 1. For anchorage to concrete, provide inserts to be cast into concrete, for bolting anchors.
 2. For anchorage to stud walls, provide backing plates, for bolting anchors.
- G. Provide slip-on non-weld mechanical fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.

2.02 STEEL RAILING SYSTEM

- A. Steel Pipe: ASTM A53/A53M, Grade B Schedule 80, black finish.
- B. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- C. Exposed Fasteners: No exposed bolts or screws.

2.03 FABRICATION

- A. Accurately form components to suit specific project conditions and for proper connection to building structure.
- B. Fit and shop assemble components in largest practical sizes for delivery to site.
- C. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- D. Welded Joints:
 1. Exterior Components: Continuously seal joined pieces by intermittent welds and plastic filler. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 2. Interior Components: Continuously seal joined pieces by intermittent welds and plastic filler.
 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply items required to be cast into concrete or embedded in masonry with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with ADA Standards and CBC Chapter 11B for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.

- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 06 10 00
ROUGH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-structural dimension lumber framing.
- B. Underlayment.
- C. Communications and electrical room mounting boards.
- D. Concealed wood blocking, nailers, and supports.
- E. Miscellaneous wood nailers, furring, and grounds.

1.02 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- B. ASTM C557 - Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing; 2003 (Reapproved 2017).
- C. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- E. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials; 2016.

1.03 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
 - 3. Lumber of other species or grades is acceptable provided structural and appearance characteristics are equivalent to or better than products specified.

2.02 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as required to meet performance of designed assemblies, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.03 CONSTRUCTION PANELS

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

2.04 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel complying with ASTM A153/A153M for high humidity and preservative-treated wood locations, unfinished steel elsewhere.

PART 3 EXECUTION

3.01 PREPARATION

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

3.02 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In framed assemblies that have concealed spaces, provide solid wood fireblocking as required by applicable local code, to close concealed draft openings between floors and between top story and roof/attic space; other material acceptable to code authorities may be used in lieu of solid wood blocking.
- C. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- D. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to two or more studs or other method of support is explicitly indicated.
- E. Where ceiling-mounting is indicated, provide blocking and supplementary supports above ceiling, unless other method of support is explicitly indicated.
- F. Provide the following specific non-structural framing and blocking:
 - 1. Cabinets and shelf supports.
 - 2. Wall brackets.
 - 3. Handrails.
 - 4. Grab bars.
 - 5. Towel and bath accessories.
 - 6. Wall-mounted door stops.
 - 7. Marker boards and Tack boards.

3.04 INSTALLATION OF CONSTRUCTION PANELS

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

3.05 CLEANING

- A. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.

END OF SECTION

SECTION 06 41 00
ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units.
- B. Countertops.
- C. Hardware.
- D. Factory finishing.
- E. Preparation for installing utilities.

1.02 DEFINITIONS

- A. AHJ: Authority (Authorities) Having Jurisdiction.
- B. CBC: California Building Code / California Code of Regulations, Title 24.
- C. HPDL: High Pressure Decorated Laminate.
- D. LPDL: Low Pressure Decorative Laminate.
- E. NEMA: National Electrical Manufacturers Association.
- F. WI: Woodwork Institute.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- B. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards; 2014, with Errata (2016).
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- D. BHMA A156.9 - American National Standard for Cabinet Hardware; 2015.
- E. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- F. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- G. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- H. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.04 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section:
<https://woodworkinstitute.com/#sle>.
 - 2. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 3. For projects under OSHPD-1, OSHPD-2, or DSA jurisdiction, comply with WI (CSIP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 4. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 5. Provide designated labels on shop drawings as required by certification program.
 - 6. Provide designated labels on installed products as required by certification program.

7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 8. Replace, repair, or rework all work for which certification is refused.
- C. Source Limitations; Obtain each type of architectural wood casework and accessories through one source from a single fabricator.
- D. Regulatory Requirements:
1. Comply with CBC seismic requirements and as required by AHJ.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.06 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 CABINETS

- A. Quality Standard: Premium Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
1. Finish - Exposed Exterior Surfaces: As indicated on Drawings.
 2. Finish - Exposed Interior Surfaces: As indicated on Drawings.
 3. Finish - Semi-Exposed Surfaces: As indicated on Drawings
 4. Finish - Concealed Surfaces: Manufacturer's option.
 5. Door and Drawer Front Edge Profiles: Square edge with thin applied band.
 6. Door and Drawer Front Retention Profiles: Fixed panel.
 7. Casework Construction Type: Type A - Frameless.
 8. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
 9. Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
 - b. Premium Grade:
 - 1) Provide vertical run and match for doors, drawer fronts and false fronts within each cabinet unit.
 10. Adjustable Shelf Loading: 50 lbs. per sq. ft.
 - a. Deflection: L/144.
 11. Cabinet Style: Flush overlay.
 12. Cabinet Doors and Drawer Fronts: Flush style.
 13. Drawer Side Construction: Multiple-dovetailed.
 14. Drawer Construction Technique: Dovetail joints.

2.02 WOOD-BASED COMPONENTS

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

2.03 LAMINATE MATERIALS

- A. Manufacturers:
1. Formica Corporation; ____: www.formica.com.
 2. Panolam Industries International, Inc; Nevamar Standard HPL: www.panolam.com.
 3. Wilsonart LLC; ____: www.wilsonart.com.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Provide specific types as follows:

1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, through color, colors as indicated, finish as indicated.
3. Flame Retardant Surfaces: HGF, 0.048 inch nominal thickness, through color, colors as indicated, finish as indicated.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
4. Cabinet Liner: CLS, 0.020 inch nominal thickness, through color, colors as indicated, finish as indicated.
5. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.04 COUNTERTOPS

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

2.05 ACCESSORIES

- A. Adhesive: Type recommended by WI to suit application.
- B. Plastic Laminate Edge Banding: HGS, 0.048 inch nominal thickness.
 1. Color: As indicated on drawings.
 2. Use at all exposed edges.
- C. Fasteners: Size and type to suit application.
- D. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- E. Concealed Joint Fasteners: Threaded steel.
- F. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.
 1. Style: Round with matching, removable cap.
 2. Size: 2 1/2 inch diameter.
 3. Provide 1 grommet for each 36" of worksurface unless otherwise indicated on the drawings. To be field located by Architect.

2.06 HARDWARE

- A. Hardware: BHMA A156.9, types as indicated for quality grade specified.
- B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome or satin chrome finish, for nominal 1 inch spacing adjustments.
- C. Fixed Americans with Disabilities Act (ADA)-Compliant Vanity and Countertop Brackets:
 1. Material: Steel.
 2. Finish: Manufacturer's standard, factory-applied primer.
- D. Drawer and Door Pulls: As indicated on drawings.
- E. Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
 1. Product: Advantage Plus Pin Tumbler Cam Door & Drawer Cabinet Locks manufactured by CompX Security Products; www.compx.com or equal.
 2. Coordinate keyway, keying, and key groups with Owner's lock shop.
- F. Drawer Slides:
 1. Type: Full extension.
 2. Static Load Capacity: Heavy Duty grade.
 3. Mounting: Side mounted.
 4. Stops: Integral type.
 5. Features: Provide self closing/stay closed type.
 6. Manufacturers:

- a. Accuride International, Inc; Heavy-Duty Drawer Slides: www accuride.com.
 - b. Knappe & Vogt Manufacturing Company; Heavy-Duty Drawer Slides: www.knapeandvogt.com.
 - c. Or equal.
- G. Hinges: European style concealed self-closing type, BHMA No. A156.9, B01601, steel with satin finish.
- 1. Manufacturers:
 - a. Häfele America Co.: www.hafele.com.
 - b. Hettich America, LP: www.hettich.com.
 - c. Blum, Inc: www.blum.com.
 - d. Stanley Commercial Hardware: www.stanleyhardwarefordoors.com.
- H. Soft Close Adapter: Concealed, frame-mounted, screw-adjustable damper ; steel with polished finish.
- 1. Manufacturers:
 - a. Grass America Inc; Unisoft: www.grassusa.com.
- I. Wall Mounted Bench Support Brackets:
- 1. Manufacturers:
 - a. Rangine Corporation; RAKKS EHB Series Bench Support Bracket: www.rakks.com.
 - b. Federal Brace; Georgian Wall Mounted Bench Support: www.federalbrace.com
 - 2. Type: Inside-wall flush mounted.
 - 3. Construction: Fabricated from horizontal aluminum T section and vertical aluminum L section. Vertical leg designed to attach to side of supporting stud and be concealed by gypsum board or other wall finish.
 - 4. Size: As recommended by manufacturer for size of counter indicated on the drawings.
 - 5. Load Capacity per bracket: 400 pounds.
 - 6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter mounted components such as keyboard trays and cable management systems.
 - 7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.
- J. Wall Mounted Vanity Support Brackets:
- 1. Manufacturers:
 - a. Rangine Corporation; RAKKS EHV Series Vanity Support Bracket: www.rakks.com.
 - b. Chemical Concepts; ADA Vanity Bracket: www.counterbalanceshop.com.
 - c. Or equal.
 - 2. Type: Surface mounted with ADA compliant panel supports.
 - 3. Removeable Panels: Provide removeable panel to conceal piping. Match adjacent casework for panel construction and finish. Provide concealed mounting hardware where available. Where concealed mounting hardware not available from bracket manufacturer, provide Removeable Panel Dismountable Connectors.
 - 4. Size: As recommended by manufacturer for size of vanity indicated on the drawings.
 - 5. Load Capacity per bracket: 400 pounds.
 - 6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter plumbing and components.
 - 7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.
- K. Removeable Panel Dismountable Connectors: Select type as appropriate for the conditions per manufacturer's recommendation.
- 1. Product: Z-Clip ZCP manufactured by Mbs Standoffs; <https://mbs-standoffs.com>.
 - 2. Product: Monarch Z Clips manufactured by Monarch Metal Fabrication; <http://www.monarchmetal.com>.

3. Product: Suspension Fittings Set manufactured by Richelieu Hardware;
<https://www.richelieu.com>.
4. Product: Striplox Clip Connector System manufactured by Richelieu Hardware;
<https://www.richelieu.com>.
5. Product: Panel Mounting System manufactured by Richelieu Hardware;
<https://www.richelieu.com>.
6. Product: EH Frame Connector & Suspension Fitting manufactured by Hafele America Co.; <https://www.hafele.com>.
7. Product: Keku Hook-on Hospa/Hospa manufactured by Hafele America Co.;
<https://www.hafele.com>.
8. Or equal

2.07 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
 3. Conceal means of fastening various items together per AWI/AWMAC/WI (AWS) requirements.
- E. Mechanically fasten back splash to countertops per AWI requirements at 16 inches on center.
- F. Provide cutouts for plumbing fixtures, inserts, appliances, outlet boxes, and fixtures and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.
- G. Finish Hardware:
 1. Fit hardware accurately and install in compliance with hardware manufacturer's printed instructions.
 2. Accurately fit doors and drawers with uniform clearance at edges.
 3. Doors and drawers shall operate freely, but not loosely, without sticking or binding, with hardware adjusted and functioning properly.
- H. Assemblies must be free of open joints, hammer and machine marks, structural defects and surface blemishes.

2.08 SHOP FINISHING

- A. Finish work in accordance with AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified:

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.
- C. Verify that openings are properly framed, are true to line, plumb, square and within allowable tolerances.
- D. Reject work that does not conform to the manufacturer's installation requirements.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

- F. Perform or arrange for required remedial work necessary to correct deficient conditions and to conform to fabricator's requirements.
- G. Proceed with the Work only after fabricator's acceptance of existing conditions.

3.02 INSTALLATION

- A. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets and counter bases to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.

3.03 ADJUSTING

- A. Test installed work for rigidity and ability to support loads.
- B. Adjust moving or operating parts to function smoothly and correctly.
- C. Lubricate moving and operating parts as necessary to function properly and to provide a smooth, quiet operation, free from warp, twist or distortion.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.
- B. Do not use cleaning materials or procedures that could change the appearance of exposed finishes or damage adjacent materials.
- C. Waste Management; After completing the Work, leave work areas free from debris, materials, equipment, and related items.

3.05 PROTECTION

- A. Protect items in place from sources of moisture, corrosion, deterioration, staining or other damage.
- B. Do not store anything adjacent to, on or against installed casework unless it is adequately protected.
- C. Do not use casework surfaces as work surfaces.
- D. Remove protection when it no longer needed and prior to Substantial Completion.

3.06 SCHEDULES

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation in interior wall and ceiling construction.
- B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.

1.02 REFERENCE STANDARDS

- A. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method; 2017.
- B. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2017.
- C. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation; 2017, with Editorial Revision (2018).
- D. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- E. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- G. ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace At 750 Degrees C; 2016a.
- H. ASTM E1414/E1414M - Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum; 2016.
- I. NFPA 285 - Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components; 2019.

1.03 QUALITY ASSURANCE

- A. Air Barrier Association of America (ABAA) Quality Assurance Program (QAP); www.airbarrier.org:
 - 1. Installer Qualification: Use accredited contractors, certified installers, evaluated materials, and third-party field quality control audit.
 - 2. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture. Use secondary materials approved in writing by primary material manufacturer.

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 APPLICATIONS

- A. Insulation on Inside of Concrete and Masonry Exterior Walls: Glass fiber board.
- B. Insulation in Metal Framed Walls: Batt insulation with integral vapor retarder.
- C. Insulation Above Lay-In Acoustical Ceilings: Batt insulation with no vapor retarder.

2.02 FOAM BOARD INSULATION MATERIALS

2.03 FIBERBOARD INSULATION MATERIALS

- A. Mineral Fiberboard Insulation: Rigid mineral fiber, in accordance with ASTM C612.

1. Facing: None, unfaced.
2. Flame Spread Index: 25 or less, when tested with facing, if any, in accordance with ASTM E84.
3. Smoke Developed Index: 50 or less, when tested with facing, if any, in accordance with ASTM E84.
4. Board Thickness: 1 inch.
5. Board Edges: Square.
6. Thermal Conductivity (k-factor): BTU inch/hr sq ft degrees F of 0.26 per inch at 75 degrees F when tested in accordance with ASTM C518.
7. Maximum Density: 8.0 pounds per cubic foot.
8. Combustibility: Except for facing, if any, non-combustible when tested in accordance with ASTM E136.

2.04 BATT INSULATION MATERIALS

- A. Where batt insulation is indicated, either glass fiber or mineral fiber batt insulation may be used, at Contractor's option.
- B. Glass Fiber Batt Insulation: Flexible preformed batt or blanket, complying with ASTM C665; friction fit.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 4. Formaldehyde Content: Zero.
 5. Facing: Aluminum foil, flame spread 25 rated; one side.
- C. Mineral Fiber Batt Insulation: Flexible or semi-rigid preformed batt or blanket, complying with ASTM C665; friction fit; unfaced flame spread index of 0 (zero) when tested in accordance with ASTM E84.
 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 0 (zero), when tested in accordance with ASTM E84.
- D. Flexible Blanket Insulation: Thin profile insulation that complies with complex shapes, unfaced; flame spread index of 5 (five) and smoke development index of 10 (ten) or less when tested in accordance with ASTM E84.
 1. Thickness: 3/8 inch.

2.05 ACCESSORIES

- A. Sheet Vapor Retarder: Black polyethylene film for above grade application, 10 mil, 0.010 inch thick.
- B. Interior Vapor Retarder: Modified polyethylene/polyacrylate (PE/PA) film reinforced with polyethylene terephthalate (PET) fibers, 12 mils, 0.012 inch thick.
- C. Tape: Reinforced polyethylene film with acrylic pressure sensitive adhesive.
 1. Application: Sealing of interior circular penetrations, such as pipes or cables.
 2. Width: Are required for application.
 3. Temperature Resistance: Minus 40 degrees F to 212 degrees F
- D. Tape: Bright aluminum self-adhering type, mesh reinforced, 2 inch wide.
- E. Tape joints of rigid insulation in accordance with roofing and insulation manufacturers' instructions.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.

- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Adhere 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
 - 1. Tape seal joints between sheets.
 - 2. Extend sheet full height of joint.
- B. Apply adhesive to back of boards:
 - 1. Three continuous beads per board length.
 - 2. Full bed 1/8 inch thick.
- C. Install boards horizontally on walls.
 - 1. Place boards to maximize adhesive contact.
 - 2. Install in running bond pattern.
 - 3. Butt edges and ends tightly to adjacent boards and protrusions.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- E. Tape insulation board joints.

3.03 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in interior wall and ceiling spaces without gaps or voids. Do not compress insulation.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.
- E. Install with factory-applied vapor retarder membrane facing warm side of building spaces. Lap ends and side flanges of membrane over framing members.
- F. Retain insulation batts in place with wire mesh secured to framing members.
- G. Tape seal butt ends, lapped flanges, and tears or cuts in membrane.
- H. At metal framing, place vapor retarder on warm side of insulation; lap and seal sheet retarder joints over face of member
- I. Tape seal tears or cuts in vapor retarder.
- J. Extend vapor retarder tightly to full perimeter of adjacent window and door frames and other items interrupting the plane of the membrane. Tape seal in place.

3.04 PROTECTION

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

END OF SECTION

SECTION 07 84 00
FIRESTOPPING

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

- A. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- B. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- C. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems; 2015 (Reapproved 2019).
- D. ASTM E2837 - Standard Test Method for Determining the Fire Resistance of Continuity Head-of-Wall Joint Systems Installed Between Rated Wall Assemblies and Nonrated Horizontal Assemblies; 2013 (Reapproved 2017).
- E. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- F. ITS (DIR) - Directory of Listed Products; current edition.
- G. FM (AG) - FM Approval Guide; current edition.
- H. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).
- I. UL 1479 - Standard for Fire Tests of Penetration Firestops; Current Edition, Including All Revisions.
- J. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with ASTM E119 and ASTM E814.
 - 1. Listing in UL (FRD), FM (AG), or ITS (DIR) will be considered as constituting an acceptable test report.
 - 2. Valid evaluation report published by ICC Evaluation Service, Inc. (ICC-ES) at www.icc-es.org will be considered as constituting an acceptable test report.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Firestopping Manufacturers:
 - 1. 3M Fire Protection Products: www.3m.com/firestop.
 - 2. A/D Fire Protection Systems Inc: www.adfire.com.
 - 3. Grabber Construction Products, Inc: www.grabberman.com.
 - 4. Hilti, Inc: www.us.hilti.com.
 - 5. Specified Technologies Inc: www.stifirestop.com.

6. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.

2.02 MATERIALS

- A. Firestopping Materials: Any materials meeting requirements.
- B. Volatile Organic Compound (VOC) Content: Provide products having VOC content lower than that required by SCAQMD 1168.
- C. Mold and Mildew Resistance: Provide firestopping materials with mold and mildew resistance rating of zero(0) in accordance with ASTM G21.
- D. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Provide type of materials as required for tested firestopping assembly.

2.03 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Head-of-Wall Joint System Firestopping at Joints Between Fire-Rated Wall Assemblies and Non-Rated Horizontal Assemblies: Use system that has been tested according to ASTM E2837 to have fire resistance F Rating equal to required fire rating of floor or wall, whichever is greater.
- B. Through Penetration Firestopping: Use system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.

2.04 FIRESTOPPING SYSTEMS

- A. Firestopping: Any material meeting requirements.
 - 1. Fire Ratings: Use system that is listed by FM (AG), ITS (DIR), or UL (FRD) and tested in accordance with ASTM E814, ASTM E119, or UL 1479 with F Rating equal to fire rating of penetrated assembly and minimum T Rating Equal to F Rating and in compliance with other specified requirements.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other materials that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.
- C. Install backing materials to prevent liquid material from leakage.

3.03 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authorities having jurisdiction.
- C. Install labeling required by code.

3.04 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.05 PROTECTION

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

END OF SECTION

SECTION 07 92 00
JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015.
- B. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants; 2018.
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017.
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2018.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2016.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2018.
- I. ASTM C1330 - Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants; 2018.
- J. SCAQMD 1168 - Adhesive and Sealant Applications; 1989 (Amended 2017).

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- C. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver to manufacturer sufficient samples for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

1.04 WARRANTY

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
 - 1. Bostik Inc: www.bostik-us.com.

2. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html.
3. Fortifiber Building Systems Group: www.fortifiber.com.
4. Hilti, Inc: www.us.hilti.com.
5. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us.
6. Pecora Corporation: www.pecora.com.
7. QUIKRETE Companies: www.quikrete.com.
8. Sherwin-Williams Company: www.sherwin-williams.com.
9. Sika Corporation: www.usa-sika.com.
10. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com.
11. W.R. Meadows, Inc: www.wrmeadows.com.

2.02 JOINT SEALANT APPLICATIONS

- A. Scope:
 1. Interior Joints: Do not seal interior joints unless specifically indicated to be sealed. Interior joints to be sealed include, but are not limited to, the following items.
 - a. Joints between door, window, and other frames and adjacent construction.
 - b. In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, piping, and other openings; between wall/ceiling and other construction; and other flanking sound paths.
 - c. Other joints indicated below.
 2. Do not seal the following types of joints.
 - a. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - b. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - c. Joints where installation of sealant is specified in another section.
 - d. Joints between suspended panel ceilings/grid and walls.
- B. Interior Joints: Use non-sag polyurethane sealant, unless otherwise indicated.
 1. Wall and Ceiling Joints in Non-Wet Areas: Acrylic emulsion latex sealant.
 2. Wall and Ceiling Joints in Wet Areas: Non-sag polyurethane sealant for continuous liquid immersion.
 3. Floor Joints in Wet Areas: Non-sag polyurethane "non-traffic-grade" sealant suitable for continuous liquid immersion.
 4. Joints between Fixtures in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 5. In Sound-Rated Assemblies: Acrylic emulsion latex sealant.
 6. Other Floor Joints: Self-leveling polyurethane "traffic-grade" sealant.
- C. Interior Wet Areas: Bathrooms, restrooms, and kitchens; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.
- D. Sound-Rated Assemblies: Walls and ceilings identified as "STC-rated", "sound-rated", or "acoustical".

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.

2.04 NONSAG JOINT SEALANTS

- A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.

4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 5. Color: Match adjacent finished surfaces.
- B. Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
 1. Color: White.
 - C. Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Color: Match adjacent finished surfaces.
 - D. Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
 1. Movement Capability: Plus and minus 35 percent, minimum.
 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: Match adjacent finished surfaces.
 - E. Acrylic Emulsion Latex: Water-based; ASTM C834, single component, non-staining, non-bleeding, non-sagging; not intended for exterior use.
 1. Color: Standard colors matching finished surfaces, Type OP (opaque).
 2. Grade: ASTM C834; Grade Minus 18 Degrees C (0 Degrees F).

2.05 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
 1. Type for Joints Not Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type O - Open Cell Polyurethane.
 2. Type for Joints Subject to Pedestrian or Vehicular Traffic: ASTM C1330; Type B - Bi-Cellular Polyethylene.
 3. Open Cell: 40 to 50 percent larger in diameter than joint width.
 4. Closed Cell and Bi-Cellular: 25 to 33 percent larger in diameter than joint width.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, non-staining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Non-corrosive and non-staining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; non-staining.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Perform acoustical sealant application work in accordance with ASTM C919.
- D. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer.
- E. Install bond breaker backing tape where backer rod cannot be used.
- F. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- G. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- H. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

3.04 FIELD QUALITY CONTROL

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

END OF SECTION

SECTION 08 11 13
HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Fire-rated hollow metal doors and frames.
- C. Accessories, including glazing and louvers.

1.02 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. ASCE: American Society of Civil Engineers.
- C. HMMA: Hollow Metal Manufacturers Association.
- D. NAAMM: National Association of Architectural Metal Manufacturers.
- E. NFPA: National Fire Protection Association.
- F. SDI: Steel Door Institute.
- G. UL: Underwriters Laboratories.

1.03 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ANSI/SDI A250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Coatings for Steel Doors and Frames; 2007 (R2011).
- C. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2011.
- D. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2014.
- E. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2011.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- G. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable; 2016.
- H. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2017.
- I. BHMA A156.115 - American National Standard for Hardware Preparation in Steel Doors and Steel Frames; 2016.
- J. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- K. ITS (DIR) - Directory of Listed Products; current edition.
- L. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- M. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- N. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; 2007.
- O. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- P. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2016.

- Q. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2016.
- R. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2018.
- S. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2013.
- T. UL (DIR) - Online Certifications Directory; Current Edition.
- U. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- V. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.05 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hollow Metal Doors and Frames:
 1. Ceco or Curries, an Assa Abloy Group company: www.assaabloydss.com.
 2. Fleming Door Products, an Assa Abloy Group company: www.assaabloydss.com.
 3. Republic Doors, an Allegion brand: www.republicdoor.com.
 4. Door Components, Inc.: www.doorcomponents.com
 5. Steelcraft, an Allegion brand: www.allegion.com.

2.02 PERFORMANCE REQUIREMENTS

- A. Requirements for Hollow Metal Doors and Frames:
 1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
 2. Accessibility: Comply with ICC A117.1 and ADA Standards.
 3. Door Top Closures: Flush end closure channel, with top and door faces aligned.
 4. Door Edge Profile: Beveled, both sides.
 5. Typical Door Face Sheets: Flush. Refer to Door Schedule for additional information.
 6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Flush.
 7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

- a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Hollow Metal Panels: Same construction, performance, and finish as doors.
- C. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.03 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 4 - Maximum-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 14 gage, 0.067 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 - 2. Core Material: Polystyrene, 1 lbs/cu ft minimum density.
 - 3. Door Thermal Resistance: R-Value of 6.0 minimum, for installed thickness of polystyrene.
 - 4. Door Thickness: 1-3/4 inch, nominal.
 - 5. Weatherstripping: Refer to Section 08 71 00.
- C. Interior Doors, Non-Fire Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 4 - Maximum-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 14 gage, 0.067 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating for wet or corrosive locations; ASTM A653/A653M.
 - 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - 3. Door Thickness: 1-3/4 inch, nominal.
- D. Fire-Rated Doors:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 4 - Maximum-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 14 gage, 0.067 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating for exterior, wet or corrosive locations; ASTM A653/A653M.
 - 2. Fire Rating: As indicated on drawings, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - 3. Temperature-Rise Rating (TRR) Across Door Thickness: In accordance with local building code and authorities having jurisdiction.
 - 4. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - a. Attach fire rating label to each fire rated unit.

5. Smoke and Draft Control Doors: Self-closing or automatic closing doors in accordance with NFPA 80 and NFPA 105, with fire-resistance-rated wall construction rated the same or greater than the fire-rated doors, and the following;
 - a. Maximum Air Leakage: 3.0 cfm/sq ft of door opening at 0.10 inch w.g. pressure, when tested in accordance with UL 1784 at both ambient and elevated temperatures.
 - b. Gasketing: as required to meet door rating performance.
 - c. Label: Include the "S" label on fire-rating label of door.
6. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
7. Door Thickness: 1-3/4 inch, nominal.

2.04 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
- C. Exterior Door Frames: Full profile/continuously welded type.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
 2. Frame Metal Thickness: 14 gage, 0.067 inch, minimum.
 3. Weatherstripping: as required to meet door performance rating.
- D. Interior Door Frames, Non-Fire Rated: Type HM - Full profile/continuously welded, Type KD - Knock-down type, as indicated in the Drawings.
 1. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- E. Door Frames, Fire-Rated: Type HM - Full profile/continuously welded, Type KD - Knock-down type, as indicated in the Drawings.
 1. Fire Rating: Same as door, labeled.
 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- F. Mullions for Pairs of Doors: Removable type, with profile similar to jambs.
- G. Borrowed Lites Glazing Frames: Construction and face dimensions to match door frames, and as indicated on drawings.
- H. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.05 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
- B. Factory Finish: Complying with ANSI/SDI A250.3, manufacturer's standard coating.
 1. Color: As indicated on drawings.

2.06 ACCESSORIES

- A. Door Window Frames: Door window frames with glazing securely fastened within door opening.
 1. Size: As indicated on drawings.
 2. Frame Material: 18 gage, 0.0478 inch, galvanized steel.
 3. Metal Finish: as selected by architect, polyester powder coating.
 4. Glazing: 1/4 inch thick, laminated glass, in compliance with requirements of authorities having jurisdiction.
- B. Glazing: Clear sheet glass, 1/4 inch (6 mm) thick, factory installed.
- C. Removable Stops: Formed sheet steel, mitered or butted corners; prepared for countersink style tamper proof screws.
- D. Astragals for Double Doors:
 1. Exterior Doors: Stainless steel, Z-shaped.

- 2. Fire-Rated Doors: Steel, shape as required for fire rating.
- E. Mechanical Fasteners for Concealed Metal-to-Metal Connections: Self-drilling, self-tapping, steel with electroplated zinc finish.
- F. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- G. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. Install prefinished frames after painting and wall finishes are complete.
- C. Install fire rated units in accordance with NFPA 80.
- D. Coordinate frame anchor placement with wall construction.
- E. Coordinate installation of electrical connections to electrical hardware items.
- F. Touch up damaged factory finishes.

3.03 TOLERANCES

- A. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- B. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.04 ADJUSTING

- A. Adjust for smooth and balanced door movement.

END OF SECTION

SECTION 08 31 00
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall and ceiling access door and frame units.

1.02 REFERENCE STANDARDS

- A. ITS (DIR) - Directory of Listed Products; current edition.
- B. UL (FRD) - Fire Resistance Directory; Current Edition.

1.03 QUALITY ASSURANCE

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

PART 2 PRODUCTS

2.01 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Wall-Mounted Units:
 - 1. Material: Steel.
 - 2. Size: 18 inch by 18 inch or as required to access concealed items.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Gypsum Board Mounting Criteria: Provide drywall bead frame with door surface flush with wall surface.
- B. Wall-Mounted Units in Wet Areas:
 - 1. Panel Material: Stainless steel.
 - 2. Size: 12 by 12 inches.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 4. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
- C. Ceiling-Mounted Units:
 - 1. Material: Steel.
 - 2. Size: 18 inch by 18 inch.
 - 3. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.

2.02 WALL AND CEILING MOUNTED UNITS

- A. Manufacturers:
 - 1. Activar Construction Products Group - JL Industries: www.activarcpg.com.
 - 2. ACUDOR Products Inc: www.acudor.com.
 - 3. Babcock-Davis: www.babcockdavis.com.
 - 4. Cendrex, Inc: www.cendrex.com.
 - 5. Or equal..
- B. Wall and Ceiling Mounted Units: Factory fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.
 - 1. Style: Exposed frame with door surface flush with frame surface.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - 2. Door Style: Single thickness with rolled or turned in edges.
 - 3. Frames: 16 gage, 0.0598 inch, minimum thickness.
 - 4. Material: Steel.
 - 5. Frames and flanges: 0.058 inch steel.
 - 6. Door panels: 0.070 inch single thickness steel sheet.
 - 7. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.

- a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
8. Steel Finish: Primed.
9. Primed and Factory Finish: Polyester powder coat; field paint to match ceiling or wall paint color; do not paint hardware. .
10. Door/Panel Size: 18" x 18", typical. For locations only requiring tool access provide 12" x 12"..
11. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Hinge: Non-Fire-Rated Units: 175 degree steel hinges with removable pin.
 - d. Latch/Lock: Tamperproof tool-operated cam latch.
12. Finish: No. 4 finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Position units to provide convenient access to concealed equipment when necessary.

END OF SECTION

SECTION 08 33 13
COILING COUNTER DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated coiling counter doors and operating hardware.

1.02 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- C. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- D. ITS (DIR) - Directory of Listed Products; current edition.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Coiling Counter Doors:
 - 1. Alpine Overhead Doors, Inc: www.alpinedoors.com.
 - 2. C.H.I. Overhead Doors: www.chiohd.com.
 - 3. Raynor Garage Doors: www.raynor.com.

2.02 COILING COUNTER DOORS

- A. Coiling Counter Doors, Non-Fire-Rated: Aluminum slat curtain.
 - 1. Mounting: Between jambs, within prepared opening.
 - 2. Nominal Slat Size: 1-1/4 inches wide.
 - 3. Slat Profile: Flat, perforated.
 - 4. Finish, Aluminum: Anodized.
 - 5. Color: As selected by Architect from manufacturer's standard range.
 - 6. Guides: Formed track; same material and finish unless otherwise indicated.
 - 7. Hood Enclosure: Manufacturer's standard; primed steel.
 - 8. Manual hand chain lift operation.
 - 9. Locking Devices: Slide bolt on inside.

2.03 MATERIALS

- A. Curtain Construction: Interlocking, single thickness slats.
 - 1. Slat Ends: Alternate slats fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
 - 2. Curtain Bottom: Fitted with angles to provide reinforcement and positive contact in closed position.
 - 3. Aluminum Slats: ASTM B221 (ASTM B221M), aluminum alloy Type 6063; minimum thickness 0.05 inch.
- B. Guide Construction: Continuous, of profile to retain door in place, with mounting brackets of same metal.
 - 1. Aluminum Guides: Extruded aluminum channel, with wool pile runners along inside.
- C. Hood Enclosure: Internally reinforced to maintain rigidity and shape.
- D. Lock Hardware:
 - 1. Slide Bolt: Provide on single-jamb side, extending into slot in guides, with padlock on one side.
- E. Roller Shaft Counterbalance: Steel pipe and torsion steel spring system, capable of producing torque sufficient to ensure smooth operation of curtain from any position and capable of

holding position at mid-travel; with adjustable spring tension; requiring 25 lb nominal force to operate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that opening sizes, tolerances and conditions are acceptable.

3.02 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- C. Securely and rigidly brace components suspended from structure.
- D. Fit and align assembly including hardware; level and plumb, to provide smooth operation.

3.03 TOLERANCES

- A. Maintain dimensional tolerances and alignment with adjacent work.
- B. Maximum Variation From Plumb: 1/16 inch.
- C. Maximum Variation From Level: 1/16 inch.
- D. Longitudinal or Diagonal Warp: Plus or minus 1/8 inch per 10 ft straight edge.

3.04 ADJUSTING

- A. Adjust operating assemblies for smooth and noiseless operation.

3.05 CLEANING

- A. Clean installed components.
- B. Remove labels and visible markings.

END OF SECTION

SECTION 08 43 13

ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.

1.02 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; 2015.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2014 (2015 Errata).
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2014.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2013.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 FIELD CONDITIONS

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

1.07 WARRANTY

- A. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- B. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: Kawneer North America; www.kawneer.com.
- B. Other Acceptable - Aluminum-Framed Storefronts Manufacturers:
 - 1. Arcadia, Inc: www.arcadiainc.com.
 - 2. C.R. Laurence Company, Inc; U.S. Aluminum: www.crl-arch.com.

3. Oldcastle BuildingEnvelope: www.oldcastlebe.com.

2.02 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Center-Set Style:
 1. Basis of Design: Kawneer North America; Series 451, 2 by 4-1/2 inch Storefront Center-Set Style: www.kawneer.com.
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 1. Arcadia, Inc: www.arcadiainc.com.
 2. C.R. Laurence Company, Inc; U.S. Aluminum: www.crl-arch.com.
 3. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com.

2.03 BASIS OF DESIGN -- SWINGING DOORS

- A. Medium Stile, Insulating Glazing, Not Thermally-Broken:
 1. Basis of Design: Kawneer North America; Series 451.
 2. Thickness: 1-3/4 inches.
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 1. Arcadia, Inc: www.arcadiainc.com.
 2. C.R. Laurence Company, Inc; U.S. Aluminum: www.crl-arch.com.
 3. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com.

2.04 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 1. Unitized, shop assembly.
 2. Glazing Rabbet: For 1 inch insulating glazing.
 3. Finish: Class I natural anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 4. Finish Color: As selected by Architect from manufacturer's standard line.
 5. Fabrication: Joints and corners flush, hairline, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
- B. Performance Requirements:
 1. Movement: Accommodate movement between storefront and perimeter framing and deflection of lintel, without damage to components or deterioration of seals.
 2. Air Infiltration: Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of wall area, measured at specified differential pressure across assembly in accordance with ASTM E283.
 3. Condensation Resistance Factor: Measure in accordance with AAMA 1503 with 1 inch insulating glass installed.
 4. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without

causing detrimental effect to system components, anchorages, and other building elements.

2.05 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections
 - 1. Framing members for interior applications need not be thermally broken.
 - 2. Glazing Stops: Flush.

2.06 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Fasteners: Stainless steel.
- C. Exposed Flashings: Aluminum sheet, 20 gage, 0.032 inch minimum thickness; finish to match framing members.
- D. Glass: As specified in Section 08 8000.
- E. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- F. Glazing Accessories: As specified in Section 08 80 00.

2.07 FINISHES

- A. Class I Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than [] thick.

2.08 FABRICATION

- A. Fabricate components with minimum clearances and shim spacing around perimeter of assembly, yet enabling installation and dynamic movement of perimeter seal.
- B. Accurately fit and secure joints and corners. Make joints flush, hairline.
- C. Prepare components to receive anchor devices. Fabricate anchors.
- D. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
- E. Arrange fasteners and attachments to conceal from view.
- F. Reinforce components internally for door hardware .
- G. Reinforce framing members for imposed loads.
- H. Finishing: Apply factory finish to all surfaces that will be exposed in completed assemblies.
 - 1. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Install hardware using templates provided.

- F. Install glass in accordance with Section 08 80 00.
- G. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

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

3.04 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.

3.05 ADJUSTING

- A. Adjust operating hardware for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 80 00

GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.

1.02 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; current edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015.
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2015).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2014.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016.
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2015.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2010.
- K. GANA (SM) - GANA Sealant Manual; 2008.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).

1.04 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.05 WARRANTY

- A. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- B. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Glass Fabricators:
 - 1. GGI - General Glass International: www.generalglass.com.
 - 2. Trulite Glass & Aluminum Solutions, LLC: www.trulite.com.
 - 3. Viracon, Inc: www.viracon.com.

4. Old Castle Building Envelope, Architectural Glass: www.obe.com..
- B. Laminated Glass Manufacturers:
1. Cardinal Glass Industries: www.cardinalcorp.com.
 2. Goldray Industries, Inc: www.goldrayglass.com.
 3. Viracon, Architectural Glass segment of Apogee Enterprises, Inc: www.viracon.com.
 4. Old Castle Building Envelope, Architectural Glass: www.obe.com..

2.02 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

- A. Provide type and thickness of interior glazing assemblies to support assembly dead loads.
1. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
 2. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7.
 3. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
 4. Glass thicknesses listed are minimum.

2.03 GLASS MATERIALS

- A. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.

2.04 INSULATING GLASS UNITS

- A. Manufacturers:
1. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
 2. AGC Glass North America, Inc: www.agcglass.com.
 3. Guardian Glass, LLC: www.guardianglass.com.
 4. Pilkington North America Inc: www.pilkington.com/na.
 5. Viracon, Apogee Enterprises, Inc: www.viracon.com.
 6. Old Castle Building Envelope, Architectural Glass: www.obe.com..
- B. Insulating Glass Units: Types as indicated.
1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 3. Metal Edge Spacers: Aluminum, bent and soldered corners.
 4. Spacer Color: Black.
 5. Edge Seal:
 - a. Dual-Sealed System: Provide polyisobutylene sealant as primary seal applied between spacer and glass panes, and silicone, polysulfide, or polyurethane sealant as secondary seal applied around perimeter.
 6. Color: Black.
 7. Purge interpane space with dry air, hermetically sealed.
- C. Type GL-1 - Insulating Glass Units: Vision glass, double glazed.
1. Applications: Interior glazing.
 2. Space between lites filled with air.
 3. Outboard Lite: Laminated, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 4. Inboard Lite: Laminated, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch.

2.05 GLAZING COMPOUNDS

- A. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding, non-staining; ASTM C920, Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; black color.

2.06 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 - 1. Width: As required for application.
 - 2. Thickness: As required for application.
 - 3. Spacer Rod Diameter: As required for application.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

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

3.02 PREPARATION

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

3.03 INSTALLATION, GENERAL

- A. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- B. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- C. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.

3.04 CLEANING

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

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

3.05 PROTECTION

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

END OF SECTION

SECTION 08 83 00

MIRRORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass mirrors.
 - 1. Annealed float glass.

1.02 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- B. ASTM C1036 - Standard Specification for Flat Glass; 2016.
- C. GANA (GM) - GANA Glazing Manual; 2008.
- D. GANA (SM) - GANA Sealant Manual; 2008.

1.03 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and GANA (SM) for glazing installation methods.
- B. Fabricate, store, transport, receive, install, and clean mirrors in accordance with manufacturer's recommendations.

1.04 WARRANTY

- A. Provide five year manufacturer warranty for reflective coating on mirrors and replacement of same.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Mirror Design Criteria: Select materials and/or provide supports as required to limit mirror material deflection to 1/200, or to the flexure limit of glass, with full recovery of glazing materials, whichever is less.
- B. Mirror Glass: Clear, annealed float glass; ASTM C1036, with copper and silver coatings, and protective overcoating.
 - 1. Thickness: 1/4 inch.
 - 2. Edges: Arrised.
 - 3. Size: As indicated on drawings.

2.02 GLAZING COMPOUNDS

- A. Silicone Sealant: ASTM C920, Type S, Grade NS, Class 25, Uses M and A; single component; chemical or solvent curing; non-bleeding, non-staining, cured Shore A hardness of 15 to 25; clear color.

2.03 ACCESSORIES

- A. Setting Blocks: Neoprene, 80 to 90 Shore A durometer hardness.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness.
- C. Glazing Tape: Preformed butyl compound; 10 to 15 Shore A durometer hardness; on release paper.
- D. Glazing Clips: Manufacturer's standard type.
- E. Mirror Attachment Accessories: Stainless steel clips.
- F. Mirror Adhesive: Silicone pre-polymer based, chemically compatible with mirror coating and wall substrate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces of mirror frames or recesses are clean, free of obstructions, and ready for installation of mirrors.

3.02 PREPARATION

- A. Clean contact surfaces with solvent and wipe dry.

3.03 INSTALLATION

- A. Install mirrors in accordance with manufacturer's recommendations.
- B. Set mirrors plumb and level, and free of optical distortion.
- C. Set mirrors with edge clearance free of surrounding construction including countertops or backsplashes.

3.04 CLEANING

- A. Remove wet glazing materials from finish surfaces.
- B. Remove labels after work is complete.
- C. Clean mirrors and adjacent surfaces.

END OF SECTION

SECTION 09 05 61

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient sheet.
 - 2. Carpet tile.
 - 3. Thin-set ceramic tile.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.

1.02 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens); 2016a.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.
- C. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- D. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.
- E. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair; 2013.
- F. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.
- B. Contractor to provide both methods of moisture testing where moisture testing is recommended by flooring manufacturer.

1.04 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing shall be performed by an independent testing agency employed and paid by Contractor.
- B. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project Owner's project contact information.
- C. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.

3. Allow at least 4 business days on site for testing agency activities.
 4. Achieve and maintain specified ambient conditions.
 5. Notify Owner when specified ambient conditions have been achieved and when testing will start.
- D. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.06 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Volatile Organic Compound (VOC) Content: Comply with Section .01 61 16 - Volatile Organic Compound (VOC) Content Restrictions
- B. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
 1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
- C. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- D. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Basis of Design:
 - a. ARDEX Engineered Cements: www.ardexamericas.com.
 - 1) Concrete floor dormant crack remediation: ARDEX Ardifix
 - 2) Concrete floor remediation for moisture control issues: ARDEX MC Rapid
 - 3) Concrete floor self-leveling underlayment for floor flatness remediation: ARDEX P51 primer, ARDEX K15

- 4) Concrete floor remediation for moisture control issues and self-leveling underlayment for floor flatness remediation: Basecoat ARDEX MC Rapid, Top Coat ARDEX K15
3. Other Acceptable Manufacturers:
 - a. Floor Seal Technology, Inc: www.floorseal.com.
 - b. LATICRETE International, Inc: www.laticrete.com.
 - c. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer: www.sikafloorusa.com.
 - d. Or equal.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 2. Preliminary cleaning.
 3. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 4. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 5. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 6. Specified remediation, if required.
 7. Patching, smoothing, and leveling, as required.
 8. Other preparation specified.
 9. Adhesive bond and compatibility test.
 10. Protection.
- C. Remediations:
 1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
 2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
 3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, permanent markers, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline

salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond or telegraph through the flooring materials.

- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.
- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.06 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
- C. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
- D. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

- A. See individual floor covering section(s) for additional requirements.
- B. Comply with recommendations of testing agency.
- C. Comply with requirements and recommendations of floor covering manufacturer.

- D. Concrete: Prepare surfaces according to ICRI 310.2R, CSP 4.
- E. Vacuum clean surfaces.
- F. Prime substrate in accordance with manufacturer's instructions. Allow to dry.
- G. Close floor openings.
- H. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- I. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.

3.10 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Gypsum Board Suspension System
- E. Acoustic insulation.
- F. Cementitious backing board.
- G. Gypsum wallboard.
- H. Joint treatment and accessories.

1.02 REFERENCE STANDARDS

- A. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 1999 (Reaffirmed 2016).
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2015.
- D. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- E. ASTM C645 - Standard Specification for Nonstructural Steel Framing Members; 2014, with Editorial Revision (2015).
- F. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2017.
- G. ASTM C754 - Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2017.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2017a.
- I. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2016.
- J. ASTM C1047 - Standard Specification for Accessories For Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- K. ASTM C1288 - Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets; 2017.
- L. ASTM C1325 - Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units; 2017a.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- N. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2016.
- O. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- P. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009 (Reapproved 2016).
- Q. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.

- R. ASTM E413 - Classification for Rating Sound Insulation; 2016.
- S. CBC - California Code of Regulations Title 24, Part 2, California Building Code; current edition.
- T. GA-216 - Application and Finishing of Gypsum Panel Products; 2016.
- U. ITS (DIR) - Directory of Listed Products; current edition.
- V. UL 263 - Standard for Fire Tests of Building Construction and Materials; Current Edition, Including All Revisions.
- W. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Current Edition, Including All Revisions.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing gypsum board installation and finishing, with minimum five years of documented experience.
- B. Copies of Documents at Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.
- B. Interior Partitions: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC of 45-49 calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Fire Rated Assemblies: Provide completed assemblies with the indicated fire-resistance rating that conforms with the fire exposure and acceptance criteria specified in ASTM E119. Fire-resistance ratings shall be established by any of the following methods or procedures:
 - 1. Prescriptive design of fire-resistance-rated building elements, components or assemblies per CBC Section 721.
 - 2. Calculations in accordance with Section 722.
 - 3. Fire-resistance designs certified by an Approved Agency.
 - 4. Fire-resistance designs having fire-resistance ratings as determined by the test procedure set forth in ASTM E119 or UL 263 and certified by an Approved Testing Laboratory.
 - a. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).
 - b. Intertek Testing Services/Warnock Hersey International/Omega Point Laboratories Assembly Design Numbers: Provide construction equivalent to that listed for the particular assembly in the current ITS (DIR).
 - 5. Engineering Judgements (EJ): Engineering analysis based on a comparison of building element, component or assemblies designs having fire-resistance ratings as determined by the test procedure set forth in ASTM E119 or UL 263. Requirements for Engineering Judgements:
 - a. Prepared and signed by a registered Professional Engineer or Fire Protection Engineer who shall be knowledgeable regarding the elements of the construction to be protected, probable behavior of that construction and the recommended system protecting it. Provide documentation of Engineer's qualifications.
 - b. Provide existing tested, listed systems that are comparable in application of cover equivalent conditions that shall be used as the basis for the EJ.
 - c. The EJ shall apply only to the specific conditions and configurations for which it was produced and shall be based upon reasonable performance expectations for the recommended fire-resistive system for the specific application.
 - d. EJs are approved for a specific condition on a project-by-project basis and shall not be used for another project or condition without thorough and appropriate review of all aspects of the EJ as it relates to that project's circumstances.

- e. EJs shall be presented in a narrative format that clearly describes all aspects of the design, including, but not limited to the hourly rating required, a complete description of all critical elements for the fire-resistive system configuration, any non-standard conditions, clear directions for the installation of the recommended system and the fire-resistive design(s) that the EJ is based on. Detailed drawings shall be included when deemed necessary to clearly illustrate the assembly.
- f. EJs shall clearly state that the recommended system is an engineering judgment and is NOT a listed system.
- g. EJs shall indicate the facility name, address, title of project, AHJ project/permit number, and include the issuer's name, title, address, telephone number and signature.

2.02 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Basis of Design;
 - a. CEMCO; www.cemcosteel.com
 - 2. Acceptable Manufacturers:
 - a. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 10 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - 5. Resilient Furring Channels: Single or double leg configuration; 1/2 inch channel depth.
 - a. Products:
 - 1) Same manufacturer as other framing materials.
- C. Partition Head To Structure Connections: Provide track fastened to structure with legs of sufficient length to accommodate deflection, for friction fit of studs cut short and fastened as indicated on drawings.
- D. Non-Loadbearing Framing Accessories:
 - 1. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.
 - 2. Partial Height Wall Framing Support: Provides stud reinforcement and anchored connection to floor.
 - 3. Framing Connectors: ASTM A653/A653M G90 galvanized steel clips; secures cold rolled channel to wall studs for lateral bracing.

2.03 GYPSUM BOARD SUSPENSION SYSTEM

- A. Gypsum board suspension system conforming to ASTM C635/C635M
 - 1. Classification; Heavy Duty
 - 2. Size: 1.6 x 1.5 inches.
 - 3. Finish: G40 hot dip galvanized.
- B. Basis of Design:
 - 1. CertainTeed Corporation; HD-FR 1.5 inch system: www.certainteed.com/ceilings.
- C. Acceptable Manufacturers:
 - 1. USG Corporation: www.usg.com.
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 BOARD MATERIALS

- A. Manufacturers - Gypsum-Based Board:
 - 1. Basis of Design:

- a. USG Corporation; www.usg.com.
- B. Acceptable Manufacturers:
 - 1. CertainTeed Corporation: www.certainteed.com.
 - 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
 - 3. National Gypsum Company: www.nationalgypsum.com.
 - 4. PABCO Gypsum: www.pabcogypsum.com.
 - 5. Or equal
- C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold resistant board is required at all locations.
 - 3. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 - 4. Thickness:
 - a. Vertical Surfaces: 5/8 inch.
 - b. Ceilings: 1/2 inch.
- D. Backing Board For Wet Areas:
 - 1. Application: Surfaces behind tile in wet areas including Restrooms, Showers, and Training Room.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 5/8 inch.
 - 4. Basis of Design:
 - a. USG Corporation; Durock: www.usg.com.
 - 5. Acceptable Products:
 - a. Custom Building Products; Wonderboard: www.custombuildingproducts.com.
 - b. National Gypsum Company; PermaBase Cement Board: www.nationalgypsum.com.
 - c. USG Corporation; Durock: www.usg.com.
 - d. Or equal
 - 6. ASTM Cement-Based Board: Non-gypsum-based, cementitious board complying with ASTM C1288.
 - a. Thickness: 5/8 inch.
 - b. Products:
 - 1) James Hardie Building Products, Inc: www.jameshardie.com.
- E. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Ceilings, unless otherwise indicated.
 - 2. Thickness: 1/2 inch.
 - 3. Edges: Tapered.
 - 4. Products:
 - a. Same manufacturer as board materials.

2.05 GYPSUM WALLBOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: 4 inch.
 - 1. Flame spread index of not more than 25 per UL 723 Test for Surface Burning Characteristics.
 - 2. Underwriters Laboratory (UL) Certification under category BKNV with designation FHC 25/50.

- B. Sound Isolation Tape: Elastomeric foam tape for sound decoupling.
 - 1. Surface Burning Characteristics: Provide assemblies with flame spread index of 75 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - 2. Tape Thickness: 1/4 inch.
- C. Acoustic Sealant: Acrylic emulsion latex or water-based elastomeric sealant; do not use solvent-based non-curing butyl sealant.
 - 1. Products:
 - a. Franklin International, Inc; Titebond GREENchoice Professional Acoustical Smoke and Sound Sealant: www.titebond.com.
 - b. Liquid Nails, a brand of PPG Architectural Coatings; AS-825 Acoustical Sound Sealant: www.liquidnails.com.
 - c. Specified Technologies Inc; Smoke N Sound Acoustical Sealant: www.stifirestop.com.
- D. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As detailed or required for finished appearance.
 - 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 - 1. Tape: 2 inch wide, coated glass fiber tape for joints and corners for backing board..
 - 2. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
 - 3. Joint Compound: Drying type, vinyl-based, ready-mixed.
 - 4. Joint Compound: Setting type, field-mixed.
- F. Finishing Compound: Surface coat and primer, takes the place of skim coating.
- G. High Build Drywall Surfer: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
 - 1. Basis of Design:
 - a. USG Corporation; Tuff-Hide: www.usg.com.
 - 2. Acceptable Products:
 - a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfer with M2Tech: www.certainteed.com.
 - b. Hamilton Drywall Products; Hamilton Prep Coat.: www.hamiltonnw.com
 - c. Solid Products, Inc.: Fast 5 Drywall Surfer: solidproductsinc.com.
- H. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inch in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion resistant.
- I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members as permitted by standard.
 - 1. Level ceiling system to a tolerance of 1/1200.
 - 2. Laterally brace entire suspension system.

- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure in all locations.
 - 2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 - 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.
- E. Standard Wall Furring: Install at concrete walls scheduled to receive gypsum board, not more than 4 inches from floor and ceiling lines and abutting walls. Secure in place on alternate channel flanges at maximum 24 inches on center.
 - 1. Orientation: Horizontal.
 - 2. Spacing: At 16 inches on center.
- F. Blocking: Install mechanically fastened steel channel blocking for support of:
 - 1. Framed openings.
 - 2. Wall mounted cabinets.
 - 3. Plumbing fixtures.
 - 4. Toilet partitions.
 - 5. Toilet accessories.
 - 6. Wall mounted door hardware.

3.03 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.
 - 2. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.04 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board parallel to framing, with ends and edges occurring over firm bearing.
 - 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
- C. Double-Layer Non-Rated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- D. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- F. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.05 INSTALLATION OF TRIM AND ACCESSORIES

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

3.06 JOINT TREATMENT

- A. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- B. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 - 1. Level 5: Walls and ceilings to receive semi-gloss or gloss paint finish and other areas specifically indicated.
 - 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 - 3. Level 3: Not used.
 - 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 - 5. Level 1: Fire rated wall areas above finished ceilings, whether or not accessible in the completed construction.
 - 6. Level 0: Temporary partitions.
- C. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 - 1. Feather coats of joint compound so that camber is maximum 1/32 inch.
- D. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- E. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.07 TOLERANCES

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

END OF SECTION

SECTION 09 30 00

TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications.
- B. Tile for wall applications.
- C. Ceramic accessories.
- D. Ceramic trim.

1.02 REFERENCE STANDARDS

- A. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium); 2017.
- B. ANSI A108.1a - American National Standard Specifications for Installation of Ceramic Tile in the Wet-Set Method, with Portland Cement Mortar; 2014.
- C. ANSI A108.1b - American National Standard Specifications for Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- D. ANSI A108.1c - Specifications for Contractors Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Bed with Dry-Set or Latex-Portland Cement; 1999 (Reaffirmed 2010).
- E. ANSI A108.4 - American National Standard Specifications for Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive; 2009 (Revised).
- F. ANSI A108.5 - American National Standard Specifications for Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- G. ANSI A108.6 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy; 1999 (Reaffirmed 2010).
- H. ANSI A108.8 - American National Standard Specifications for Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout; 1999 (Reaffirmed 2010).
- I. ANSI A108.9 - American National Standard Specifications for Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout; 1999 (Reaffirmed 2010).
- J. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework; 1999 (Reaffirmed 2010).
- K. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2010 (Reaffirmed 2016).
- L. ANSI A108.12 - American National Standard for Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar; 1999 (Reaffirmed 2010).
- M. ANSI A108.13 - American National Standard for Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone; 2005 (Reaffirmed 2010).
- N. ANSI A118.1 - American National Standard Specifications for Dry-Set Cement Mortar; 2012 (Revised).
- O. ANSI A118.6 - American National Standard Specifications for Standard Cement Grouts for Tile Installation; 2010 (Reaffirmed 2016).
- P. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes For Thin-Set Ceramic Tile And Dimension Stone Installation; 2014.

- Q. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation; 2014.
- R. ANSI A118.13 - American National Standard Specifications for Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation; 2014.
- S. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar; 2012.
- T. ANSI A137.1 - American National Standard Specifications for Ceramic Tile; 2012.
- U. ASTM C847 - Standard Specification for Metal Lath; 2014a.
- V. ASTM E492 - Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine; 2009, with Editorial Revision (2016).
- W. ASTM E2179 - Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors; 2003 (Reapproved 2016).
- X. ISO 13007 - Standards for Ceramic Tiles, Adhesives and Grouts; current edition
- Y. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation; 2017.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- B. Installer Qualifications:
 - 1. Company specializing in performing tile installation, with minimum of five years of documented experience.

1.04 DELIVERY, STORAGE, AND HANDLING

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

1.05 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 TILE

- A. Basis of Design Manufacturer:
 - 1. Refer to Interior Design Drawings, Sheet ID600.
- B. Acceptable Manufacturers:
 - 1. As indicated on sheet ID600.
 - 2. Spec Ceramics: <http://specceramics.com>
 - 3. Dal-Tile Corporation: www.daltile.com.
 - 4. American Olean Corporation: www.americanolean.com.
 - 5. Emser Tile, LLC: www.emser.com.
- C. Glazed Wall Tile: ANSI A137.1, standard grade.
 - 1. Edges: Cushioned.
 - 2. Surface Finish: High gloss.
 - 3. Color(s): As indicated on drawings.
 - 4. Pattern: As indicated on drawings.
 - 5. Trim Units: Matching bead, bullnose, cove, and base shapes in sizes coordinated with field tile.
- D. Porcelain Tile: ANSI A137.1, standard grade.

1. Abrasion Resistance: ISO 10545-7; PEI 5.
2. Thermal Shock Resistance: ISO 10545-9; Resistant.
3. Frost Resistance: ISO 10545-12; Resistant.
4. Chemical Resistance: ISO 10545-13; Resistant.
5. Color(s): As indicated on drawings.
6. Pattern: As shown on the Drawings.

2.02 TRIM AND ACCESSORIES

- A. Ceramic Accessories: Unglazed finish, same color and finish as adjacent field tile; same manufacturer as tile.
- B. Ceramic Trim: Matching bullnose ceramic shapes in sizes coordinated with field tile.
 1. Applications:
 - a. Open Edges: Bullnose.
 - b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Straight base.
 2. Manufacturers: Same as for tile.
- C. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.

2.03 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15 and ISO 13007: C2ES2.
 1. Basis of Design:
 - a. Custom Building Products; MegaLite Ultimate Crack Prevention Large Format Tile Mortar: www.custombuildingproducts.com.
 2. Other Acceptable Products:
 - a. ARDEX Engineered Cements; ARDEX S 28 MICROTEC: www.ardexamericas.com.
 - b. LATICRETE International, Inc; LATICRETE 254 Platinum: www.laticrete.com.
 - c. MAPEI Corporation; UltraFlex 3: www.mapei.com;
- C. Dry-Set Portland Cement Mortar Bond Coat: ANSI A118.1.
 1. Basis of Design Product:
 - a. Custom Building Products: www.custombuildingproducts.com.
 2. Acceptable Manufacturers:
 - a. Custom Building Products: www.custombuildingproducts.com.
 - b. MAPEI Corporation: <http://www.Mapei.com>; Kerabond T.
- D. Mortar Bed Materials: Pre-packaged mix of Portland cement, sand, latex additive, and water.
 1. Basis of Design Product:
 - a. Custom Building Products: www.custombuildingproducts.com.
 2. Acceptable Manufacturers:
 - a. LATICRETE International, Inc; LATICRETE 3701 Fortified Mortar Bed: www.laticrete.com.
 - b. MAPEI Corporation: Modified Mortar Bed; <http://www.Mapei.com>

2.04 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 1. Basis of Design:
 - a. Custom Building Products; <http://www.custombuildingproducts.com>
 2. Acceptable Manufacturers:
 - a. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com.
 - b. MAPEI Corporation: UltraColor Plus; <http://www.Mapei.com>

- C. Standard Grout: ANSI A118.6 standard cement grout.
 - 1. Applications: Use this type of grout where indicated .
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): Refer to Interior Design Drawings, Sheet ID-600.
 - 4. Products:
 - a. Custom Building Products; Polyblend Non-Sanded Grout: www.custombuildingproducts.com.
 - b. LATICRETE International, Inc; LATICRETE 1500 Sanded Grout: www.laticrete.com.
- D. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.

2.05 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com.
 - b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com.
 - c. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - 2. Products:
 - a. Merkrete, by Parex USA, Inc; Merkrete Grout Sealer: www.merkrete.com.
- C. Tile Sealer: Stain protection for natural stone.
 - 1. Products:
 - a. Custom Building Products; Aqua Mix Enrich 'N' Seal: www.custombuildingproducts.com.
 - b. STONETECH, a division of LATICRETE international, Inc; STONETECH Heavy Duty Stone Sealer: www.laticrete.com.

2.06 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.10 and A118.12.
 - 1. Crack Resistance: No failure at 1/8 inch gap, minimum.
 - 2. Products:
 - a. Basis of Design:
 - 1) Custom Building Products; RedGard Waterproofing and Crack Isolation Prevention Membrane; <http://www.custombuildingproducts.com>
- B. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- C. Metal Lath: ASTM C847, Flat diamond mesh, of weight to suit application, galvanized finish.
- D. Underlayment at Floors: Specifically designed for bonding to thin-set setting mortar; not primarily a waterproofing material and having the following characteristics:
 - 1. Sound Reduction: Comply with ANSI A118.13, bonded membrane, ASTM E492, and ASTM E2179.
 - 2. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
 - 3. Water Resistance: Comply with ANSI A118.10, bonded waterproofing.
 - 4. Type: Fluid or Trowel Applied.
 - a. Products:

- 1) Custom Building Products; FractureFree Crack Prevention Membrane; <http://www.custombuildingproducts.com>
- E. Backer Board: Refer to Section 09 21 16 - Gypsum Board Assemblies.
- F. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of setting materials to sub-floor surfaces.
- D. Verify that concrete sub-floor surfaces are ready for tile installation by testing for moisture emission rate and alkalinity; obtain instructions if test results are not within limits recommended by tile manufacturer and setting materials manufacturer.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Protect surrounding work from damage.
- B. Vacuum clean surfaces and damp clean.
- C. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- D. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- E. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.03 INSTALLATION - GENERAL

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

3.04 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Use uncoupling membrane under all tile unless other underlayment is indicated.
 - 2. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
- B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.05 INSTALLATION - FLOORS - MORTAR BED METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F111, with cleavage membrane, unless otherwise indicated.
- B. Cleavage Membrane: Lap edges and ends.
- C. Waterproofing Membrane: Install as recommended by manufacturer and as specified in the section in which the product is specified.
- D. Mortar Bed Thickness: 5/8 inch, unless otherwise indicated.

3.06 INSTALLATION - SHOWERS WALLS

- A. At tiled shower receptors install in accordance with TCNA (HB) Method B415, mortar bed floor, and W244, thin-set over cementitious backer unit walls.
- B. Grout with standard grout as specified above.

3.07 INSTALLATION - WALL TILE

- A. Over cementitious backer units over gypsum board on studs, install in accordance with TCNA (HB) Method W244C .
- B. Over gypsum wallboard on wood or metal studs install in accordance with TCNA (HB) Method W243, thin-set with dry-set or latex-Portland cement bond coat, unless otherwise indicated.

3.08 CLEANING

- A. Clean tile and grout surfaces.

3.09 PROTECTION

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

END OF SECTION

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.02 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; 2016.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- C. ASTM C635/C635M - Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2017.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels; 2013.
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2016a.
- F. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions; 2017.
- G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.
- H. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.04 QUALITY ASSURANCE

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

1.05 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. Armstrong World Industries, Inc; Optima: www.armstrong.com.
 - 2. CertainTeed Corporation; Performa RX Symphony F: www.certainteed.com.
 - 3. USG; Halcyon Panels: www.usg.com.
- B. Suspension System Basis of Design:
 - 1. Rockfon, LLC; Chicago Metallic™ 1200 Seismic 15/16" Exposed: www.rockfon.com.
- C. Acceptable Manufacturers:
 - 1. Armstrong World Industries, Inc; Prelude XL 15/16" Exposed Tee: www.armstrong.com.
 - 2. CertainTeed Corporation; Seismic Secure Classic Stab System: www.certainteed.com.

3. USG; Donn Brand DX/DXL26 Acoustical Suspension System: www.usg.com.

2.02 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
 1. Local authorities having jurisdiction.

2.03 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
 1. VOC Content: Certified as Low Emission by one of the following:
 - a. Product listing in UL (GGG).
- B. Glass Fiber Acoustical Panels: Vinyl faced glass fiber, ASTM E1264 Type XII, with the following characteristics:
 1. Size: 24 by 24 inches.
 2. ASTM E 1264 Classification: Type XII; Form 2; Pattern E.
 3. Classification Performance per ASTM E 1264: Class A, Flame Spread 25 or less.
 4. Classification Performance per ASTM E 84: Smoke Developed 50 or less.
 5. Thickness: 3/4 inches.
 6. Light Reflectance: 90 percent, determined in accordance with ASTM E1264.
 7. NRC Rating: 0.95, determined in accordance with ASTM E1264.
 8. Ceiling Attenuation Class (CAC): 25, determined in accordance with ASTM E1264.
 9. Edge: Square.
 10. Surface Color: White.
 11. Washable Finish.
 12. Mildew Resistant.
 13. Suspension System: Exposed grid.
 14. Products:
 - a. Armstrong World Industries, Inc; Optima Health Zone: www.armstrong.com..

2.04 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Steel Suspension System: Formed steel, commercial quality cold rolled; heavy-duty.
 1. Profile: Tee; 15/16 inch wide face.
 2. Construction: Double web.
 3. Classification: Heavy Duty.
 4. Finish: White painted.

2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12-gage 0.08 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
- E. Perimeter Moldings: Same material and finish as grid.

- F. Seismic Clips: 2 inch beam end retaining clip that joins main beam or cross tee to wall molding and web of grid with no visible pop rivets.
- G. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.
- B. Coordinate the location of hangers with other work.
- C. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Provide hanger clips during steel deck erection. Provide additional hangers and inserts as required.
- F. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- G. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.
- H. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- I. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- J. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- K. Do not eccentrically load system or induce rotation of runners.
- L. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.
- M. Form expansion joints as detailed. Form to accommodate plus or minus 1 inch movement. Maintain visual closure.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.

- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Cut to fit irregular grid and perimeter edge trim.
 - 2. Make field cut edges of same profile as factory edges.
 - 3. Double cut and field paint exposed reveal edges.
- G. Where round obstructions occur, provide preformed closures to match perimeter molding.
- H. Lay acoustical insulation for a distance of 48 inches either side of acoustical partitions as indicated.
- I. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- J. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 TOLERANCES

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

END OF SECTION

SECTION 09 65 00
RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

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

1.02 REFERENCE STANDARDS

- A. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2017.
- B. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.
- C. ASTM F1344 - Standard Specification for Rubber Floor Tile; 2015.
- D. ASTM F1859 - Standard Specification for Rubber Sheet Floor Covering Without Backing; 2014, with Editorial Revision (2016).
- E. ASTM F1861 - Standard Specification for Resilient Wall Base; 2016.
- F. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- G. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.
- H. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source; 2015.
- I. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2011.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.04 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least five years of experience.
 - 1. Approved by flooring manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Protect roll materials from damage by storing on end.
- E. Do not double stack pallets.

1.06 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 SHEET FLOORING

- A. Rubber Sheet Flooring:
- B. Basis of Design:
 - 1. Refer to Interior Drawings, Sheet ID-600.
- C. Products:
 - 1. Refer to Interior Design Drawings, Sheet ID-600.
- D. Rubber Sheet Flooring: 100 percent rubber composition, color and pattern through total thickness.
 - 1. Minimum Requirements: Comply with ASTM F1859, Type 1, without backing.
 - 2. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 3. Thickness: 0.125 inch minimum.
 - 4. Seams: Heat welded.
 - 5. Pattern: As shown on drawings..
 - 6. Color: As indicated on drawings.
- E. Welding Rod: Solid bead in material compatible with flooring, produced by flooring manufacturer for heat welding seams, and in color matching field color.
- F. Welding Rod for Seamless Pattern matching non-solid colors for patterned flooring.: Manufacturer's stranded through-colored welding rods that match the color and design of the floor covering pattern.
 - 1. Colors: As Selected by Architect.

2.02 TILE FLOORING

- A. Rubber Tile: Homogeneous, color and pattern throughout thickness.
 - 1. Minimum Requirements: Comply with ASTM F1344, of Class corresponding to type specified.
 - 2. Size: As indicated on drawings.
 - 3. Total Thickness: 0.125 inch.
 - 4. Color: As indicated on drawings.

2.03 RESILIENT BASE

- A. Basis of Design:
 - 1. Johnsonite
- B. Products:
 - 1. Refer to Interior Design Drawings, Sheet ID-600:
- C. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style B, Cove.
 - 1. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648 or NFPA 253.
 - 2. Height: 4 inch.
 - 3. Thickness: 0.125 inch.
 - 4. Finish: Satin.
 - 5. Color: As indicated on drawings.
 - 6. Accessories: Premolded external corners and internal corners.
- D. Acceptable Manufacturers:
 - 1. Burke Flooring: www.burkemercer.com.
 - 2. Mannington: <http://www.mannington.com/commercial>
 - 3. Roppe Corp: www.roppe.com.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by adhesive material manufacturer.

- B. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
- C. Moldings, Transition and Edge Strips: As indicated on the drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for resilient flooring installation by testing for moisture and pH.
 - 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 - 2. Obtain instructions if test results are not within limits recommended by resilient flooring manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Remove existing resilient flooring and flooring adhesives; follow the recommendations of RFCI (RWP).
- B. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- C. Remove subfloor ridges and bumps. Fill minor low spots, cracks, joints, holes, and other defects with subfloor filler to achieve smooth, flat, hard surface.
- D. Prohibit traffic until filler is fully cured.
- E. Clean substrate.

3.03 INSTALLATION - GENERAL

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

3.04 INSTALLATION - SHEET FLOORING

- A. Lay flooring with joints and seams parallel to longer room dimensions, to produce minimum number of seams. Lay out seams to avoid widths less than 1/3 of roll width; match patterns at seams.
- B. Seal seams by heat welding.

3.05 INSTALLATION - TILE FLOORING

- A. Mix tile from container to ensure shade variations are consistent when tile is placed, unless otherwise indicated in manufacturer's installation instructions.
- B. Lay flooring with joints and seams parallel to building lines to produce symmetrical pattern.
- C. Install plank tile with a random offset of at least 6 inches from adjacent rows.

3.06 INSTALLATION - RESILIENT BASE

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

3.07 CLEANING

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

3.08 PROTECTION

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

END OF SECTION

SECTION 09 68 13
TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.02 REFERENCE STANDARDS

- A. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials; 2016.
- B. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source; 2017.
- C. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2017.
- D. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2016a.
- E. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2017.
- F. CRI 104 - Standard for Installation of Commercial Carpet; 2015.
- G. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.

1.03 QUALITY ASSURANCE

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

1.04 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Tile Carpeting:
 - 1. Refer to sheet ID-600.
 - 2. Interface, Inc: www.interface.com.
 - 3. Milliken & Company: www.milliken.com.
 - 4. Mohawk Group: www.mohawkgroup.com.

2.02 MATERIALS

- A. Tile Carpeting: Tufted, manufactured in one color dye lot.
 - 1. Tile Size: 18 by 18 inch, nominal.
 - 2. Color: as indicated on drawings.
 - 3. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 - 4. VOC Content: Provide CRI (GLP) certified product; in lieu of labeling, independent test report showing compliance is acceptable.

2.03 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Edge Strips: Embossed aluminum, _____ color.
- C. Adhesives:

1. Compatible with materials being adhered; maximum VOC content of 50 g/L; CRI (GLP) certified; in lieu of labeled product, independent test report showing compliance is acceptable.

D. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Test as Follows:
 - a. Alkalinity (pH): ASTM F710.
 - b. Internal Relative Humidity: ASTM F2170.
 - c. Moisture Vapor Emission: ASTM F1869.
 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.
- D. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

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

3.03 INSTALLATION

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

3.04 CLEANING

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

END OF SECTION

SECTION 09 91 23
INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
 - b. In finished areas, paint shop-primed items.
 - c. Paint interior surfaces of air ducts that are visible through grilles and louvers with one coat of flat black paint to visible surfaces.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Stainless steel, anodized aluminum, bronze, terne coated stainless steel, and lead items.
 - 6. Marble, granite, slate, and other natural stones.
 - 7. Floors, unless specifically indicated.
 - 8. Ceramic and other tiles.
 - 9. Glass.
 - 10. Acoustical materials, unless specifically indicated.
 - 11. Concealed pipes, ducts, and conduits.

1.02 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2016.
- C. ASTM D4258 - Standard Practice for Surface Cleaning Concrete for Coating; 2005 (Reapproved 2017).
- D. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- E. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- F. SSPC-SP 2 - Hand Tool Cleaning; 1982, with Editorial Revision (2004).
- G. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- H. SSPC-SP 13 - Surface Preparation of Concrete; 1997 (Reaffirmed 2003).

1.04 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum five years experience.

1.05 DELIVERY, STORAGE, AND HANDLING

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

1.06 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- D. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 - 1. Dunn Edwards Paint: <https://www.dunnedwards.com/>
 - 2. PPG Paints: www.ppgpaints.com.
 - 3. Sherwin-Williams Company: www.sherwin-williams.com.
 - 4. Benjamin Moore Paint.
 - 5. Or equal.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:

- a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
- b. Architectural coatings VOC limits of the State in which the Project is located.
- 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Flammability: Comply with applicable code for surface burning characteristics.
- D. Sheens: Provide the sheens as indicated on drawings; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- E. Colors: As indicated on drawings.
 - 1. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling they are mounted on/under.

2.03 PAINT SYSTEMS - INTERIOR

- A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, concrete, uncoated steel, shop primed steel, and galvanized steel.
 - 1. Two top coats and one coat primer.
 - 2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.
 - 3. Primer: As recommended by top coat manufacturer for specific substrate.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 - 1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.

2.05 ACCESSORY MATERIALS

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

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Test shop-applied primer for compatibility with subsequent cover materials.
- F. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Concrete: 12 percent.
 - 3. Concrete Floors and Traffic Surfaces: 8 percent.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.

- D. Remove surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Concrete:
 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 2. Clean concrete according to ASTM D4258. Allow to dry.
 3. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- H. Concrete Floors and Traffic Surfaces: Remove contamination, acid etch, and rinse floors with clear water. Verify required acid-alkali balance is achieved. Allow to dry.
- I. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- J. Insulated Coverings: Remove dirt, grease, and oil from canvas and cotton.
- K. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 2. Prepare surface according to SSPC-SP 2.
- L. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- M. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

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

3.04 CLEANING

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

3.05 PROTECTION

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

END OF SECTION

SECTION 10 11 00
VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Markerboards
- B. Tackboards

1.02 REFERENCE STANDARDS

- A. ANSI A135.4 - American National Standard for Basic Hardboard; 2012.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling; 2009a (Reapproved 2016).
- C. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2017.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

1.03 QUALITY ASSURANCE

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

1.04 WARRANTY

- A. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. ADP Lemco, Inc: www.adplemco.com.
- B. Claridge Products and Equipment, Inc: www.claridgeproducts.com.
- C. MooreCo, Inc: www.moorecoinc.com.
- D. Nelson Adams NACO: www.nelsonadamsnaco.com.
- E. Polyvision Corporation: www.polyvision.com.

2.02 VISUAL DISPLAY UNITS

- A. Markerboards: Glass, non-magnetic, dry erase markerboard.
 - 1. Color: As indicated on drawings.
 - 2. Size: As indicated on drawings.
 - 3. Accessories: Provide concealed mount Invisi-mount.
 - 4. Manufacturers:
 - a. Basis of design: Claridge Products; Claridge Glass, Non-Magnetic Dry Erase Markerboard: www.claridgeproducts.com.
- B. Tackboards: Linoleum, homogeneous tackable surface.
 - 1. Linoleum Thickness: 1/4 inch.
 - 2. Color: As indicated on drawings.
 - 3. Size: As indicated on drawings.
 - 4. Accessories: Provide Adhesive, type as recommended by manufacturer.
 - 5. Manufacturers:
 - a. Basis of design: Forbo Flooring Systems; Bulletin board tackable surface sheet material: www.forboflooring.com.

2.03 ACCESSORIES

- A. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- B. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as instructed by the manufacturer.
- C. Verify flat wall surface for frameless adhesive-applied boards.

3.02 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Secure units level and plumb.
- C. Butt Joints: Install with tight hairline joints.
- D. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Date of Substantial Completion.

END OF SECTION

SECTION 10 14 00

SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Room and door signs.
- B. Interior directional and informational signs.
- C. Building identification signs.
- D. Super Graphic sports and branding signs.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- C. ICC A117.1 - Accessible and Usable Buildings and Facilities; 2017.
- D. CBC - California Building Code, Title 24, Part 2; 2013 Edition.

1.03 QUALITY ASSURANCE

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

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store tape adhesive at normal room temperature.

1.05 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain this minimum temperature during and after installation of signs.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flat Signs:
 - 1. Best Sign Systems, Inc: www.bestsigns.com.
 - 2. Cosco Industries (ADA signs): www.coscoarchitecturalsigns.com.
 - 3. FASTSIGNS: www.fastsigns.com.
 - 4. Seton Identification Products: www.seton.com/aec.

2.02 SIGNAGE APPLICATIONS

- A. Accessibility Compliance: Signs are required to comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most comprehensive and specific requirements.
- B. Room and Door Signs: Provide a sign for every doorway, whether it has a door or not, not including corridors, lobbies, and similar open areas.
 - 1. Sign Type: Flat signs with engraved panel media as specified.
 - 2. Provide "tactile" signage, with letters raised minimum 1/32 inch and Grade II braille.
 - 3. Character Height: 1 inch.
 - 4. Sign Height: 2 inches, unless otherwise indicated.
 - 5. Doors: Identify with room names and numbers to be determined later, not those indicated on drawings.

6. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.
 7. Rest Rooms: Identify with pictograms, the name "MEN", "WOMEN", and "ALL GENDER", and braille.
- C. Interior Directional and Informational Signs:
1. Sign Type: Same as room and door signs.
- D. Building Identification Signs:
1. Use individual metal letters.
 2. Mount on outside wall in location indicated on drawings.

2.03 SIGN TYPES

- A. Flat Signs: Signage media without frame.
1. Edges: Square.
 2. Corners: Square.
 3. Wall Mounting of One-Sided Signs: Tape adhesive.
 4. Wall and Ceiling Mounting of Two-Sided Signs: Aluminum wall bracket, powder coated, color selected from manufacturer's standard colors, attached with screws in predrilled mounting holes, set in clear silicone sealant.
- B. Color and Font: Unless otherwise indicated:
1. Character Font: Helvetica, Arial, or other sans serif font.
 2. Character Case: Upper case only.
 3. Background Color: As selected by Architect from manufacturer's full line of available colors.
 4. Character Color: Contrasting color.

2.04 TACTILE SIGNAGE MEDIA

- A. Engraved Panels: Laminated colored plastic; engraved through face to expose core as background color:
1. Total Thickness: 1/16 inch.

2.05 ACCESSORIES

- A. Concealed Screws: Stainless steel, galvanized steel, chrome plated, or other non-corroding metal.
- B. Tape Adhesive: Double sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

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

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install neatly, with horizontal edges level.
- C. Locate signs and mount at heights indicated on drawings and in accordance with ADA Standards and ICC A117.1.
- D. Protect from damage until Substantial Completion; repair or replace damaged items.

END OF SECTION

SECTION 10 21 13.17
PHENOLIC TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic toilet and shower compartments.
- B. Urinal and vestibule screens.

1.02 REFERENCE STANDARDS

- A. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- B. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

PART 2 PRODUCTS

2.01 PHENOLIC TOILET COMPARTMENTS

- A. Toilet and Shower Compartments: Factory fabricated doors, pilasters, and divider panels made of solid phenolic core panels with integral melamine finish, floor-to-ceiling.
- B. Doors:
 - 1. Thickness: 3/4 inch.
 - 2. Width: 24 inch.
 - 3. Width for Handicapped Use: 36 inch, out-swinging.
 - 4. Height: 58 inch (partial height), refer to ceiling height for full height)
- C. Panels:
 - 1. Thickness: 1/2 inch.
 - 2. Height: 58 inch (partial height), refer to ceiling heights for full height)
- D. Pilasters:
 - 1. Thickness: 3/4 inch.
 - 2. Width: As required to fit space; minimum 3 inch.
- E. Screens: Without doors; to match compartments; mounted to wall with two panel brackets.

2.02 ACCESSORIES

- A. Pilaster Shoes: Formed ASTM A666, Type 304 stainless steel with No. 4 finish, 3 inch high, concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
 - 2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Attachments, Screws, and Bolts: Stainless steel, tamper proof type.
- C. Hardware: Polished stainless steel:
 - 1. Pivot hinges, gravity type, adjustable for door close positioning; two per door.
 - 2. Nylon bearings.
 - 3. Door Latch: Slide type with exterior emergency access feature.
 - 4. Door strike and keeper with rubber bumper; mounted on pilaster in alignment with door latch.
 - 5. Coat hook with rubber bumper; one per compartment, mounted on door.
 - 6. Provide door pull for outswinging doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Maximum Variation From True Position: 1/4 inch.
- B. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.
- B. Adjust hinges to position doors in full closed position when unlatched. Return out-swinging doors to closed position.
- C. Adjust adjacent components for consistency of line or plane.

END OF SECTION

SECTION 10 26 00
WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2010, with Editorial Revision (2015).
- C. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2014.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- E. ASTM F476 - Standard Test Methods for Security of Swinging Door Assemblies; 2014.
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

1.03 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Store products in either horizontal or vertical position, in compliance with manufacturer's instructions.

1.04 WARRANTY

- A. Provide five year manufacturer and installer warranty for metal crash rails.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Corner Guards:
 - 1. Basis of design: Koroseal, Korogard; Stainless Steel Corner Guard: www.koroseal.com.

2.02 PERFORMANCE CRITERIA

- A. Impact Strength: Unless otherwise noted, provide protection products and assemblies that have been successfully tested for compliance with applicable provisions of ASTM D256 and/or ASTM F476.
- B. Chemical and Stain Resistance: Unless otherwise noted, provide protection products and assemblies with chemical and stain resistance complying with applicable provisions of ASTM D543.
- C. Fungal Resistance: Unless otherwise noted, provide protection products and assemblies which pass ASTM G21 testing.

2.03 PRODUCT TYPES

- A. Corner Guards - Surface Mounted, Stainless Steel:
 - 1. Material: Type 304 stainless steel, No. 4 finish, 16 gage, _____ inch thick.
 - 2. Width of Wings: 2 inches.
 - 3. Corner: Square.
 - 4. Color: #4 Satin.
 - 5. Length: 68 inch, One piece.
- B. Adhesives and Primers: As recommended by manufacturer.

- C. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.

2.04 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.
- B. Position corner guard 4 inches above finished floor to 72 inches high.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/8 inch.

3.04 CLEANING

- A. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 28 00
TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories.
- B. Commercial shower and bath accessories.
- C. Healthcare accessories.
- D. Under-lavatory pipe supply covers.
- E. Utility room accessories.

1.02 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASME A112.18.9 - Protectors/Insulators for Exposed Waste and Supplies on Accessible Fixtures; 2011.
- C. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service; 2015a.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- F. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Commercial Toilet Accessories:
 - 1. Bobrick Products; As per District Standards: www.bobrick.com.
 - 2. Substitutions: Not permitted.
- B. Under-Lavatory Pipe Supply Covers:
 - 1. Plumberex Specialty Products, Inc: www.plumberex.com.
- C. Provide products of each category type by single manufacturer.

2.02 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Adhesive: Two component epoxy type, waterproof.
- E. Fasteners, Screws, and Bolts: Stainless Steel; tamper-proof; security type.

2.03 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.

2.04 COMMERCIAL TOILET ACCESSORIES

- A. Toilet Paper Dispenser: Double roll, surface mounted.
- B. Paper Towel Dispenser: Roll type, touchless, stainless steel, surface-mounted. .
- C. Waste Receptacle: Stainless steel, freestanding style.
 - 1. Liner: Removable, heavy-duty vinyl liner, attached at a minimum of four points with stainless steel grommets and hooks.
 - 2. Minimum capacity: 10 gallons.
- D. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.
 - 1. Minimum Capacity: 48 ounces.
- E. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
 - 1. Minimum capacity: 250 seat covers.
- F. Grab Bars: Stainless steel, smooth surface.
 - 1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, exposed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin.
 - d. Length and Configuration: As indicated on drawings, ADA, and CBC Chapter 11B.
- G. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.

2.05 COMMERCIAL SHOWER AND BATH ACCESSORIES

- A. Shower Curtain Rod, for Private Shower Rooms: Stainless steel tube, 1 inch outside diameter, 0.04 inch wall thickness, satin-finished, with 3 inch outside diameter, minimum 0.04 inch thick satin-finished stainless steel flanges, for installation with exposed fasteners.
- B. Shower Curtain, for Private Shower Rooms:
 - 1. Material: Opaque vinyl, 0.008 inch thick, matte finish, with antibacterial treatment, flameproof and stain-resistant.
- C. Folding Shower Seat: Wall-mounted surface; welded tubular seat frame, structural support members, swing-down legs, hinges, and mechanical fasteners of Type 304 stainless steel, L-shaped, right hand and L-shaped, left hand seat.
 - 1. Seat: Phenolic or polymeric composite one-piece seat or seat slats, of white color.
 - 2. Size: ADA Standards compliant.
- D. Wall-Mounted Soap Dish: Heavy duty, seamless stainless steel, surface-mounted with drain holes, without grab bar, satin finish; with concealed mechanical fastening suitable for substrate and backplate.
- E. Towel Bar: Stainless steel, 3/4 inch square tubular bar; rectangular brackets, concealed attachment, satin finish.
 - 1. Length: 24 inches.
- F. Towel Pin: Stainless steel, 3 inch extension from wall; rectangular-shaped bracket and backplate for concealed attachment, satin finish.
- G. Robe Hook: Heavy-duty stainless steel, single-prong, rectangular-shaped bracket and backplate for concealed attachment, satin finish.

2.06 HEALTHCARE ACCESSORIES

- A. PPE Dispensers, one per locker room
 - 1. PPE Dispensers - General:

- a. Construction: Powder-coated steel housing with adjustable shelves for PPE products; side-hinged door with dispensing cut-outs and keyless locking mechanism.
- b. Universally sized to fit boxes of major brands of PPE supplies, including earloop-style face masks, gloves, isolation gowns, and tissues.
- c. Mounting: Surface mounted.
- 2. Hand Sanitizer Dispenser, one per locker room and team locker room:
 - a. Capacity: One hand sanitizer dispenser.

2.07 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Under-Lavatory Pipe and Supply Covers:
 - 1. Insulate exposed drainage piping including hot, cold, and tempered water supplies under lavatories or sinks to comply with ADA Standards.
 - 2. Exterior Surfaces: Smooth non-absorbent, non-abrasive surfaces.
 - 3. Construction: 1/8 inch flexible PVC.
 - a. Surface Burning Characteristics: Flame spread index of 25 or less and smoke developed index of 450 or less, when tested in accordance with ASTM E84.
 - b. Microbial and Fungal Resistance: Comply with ASTM G21.
 - 4. Color: White.
 - 5. Fasteners: Reusable, snap-locking fasteners with no sharp or abrasive external surfaces.

2.08 UTILITY ROOM ACCESSORIES

- A. Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, hat-shaped channel.
 - 1. Holders: Four spring-loaded rubber cam holders.
 - 2. Length: 36 inches.
 - 3. Length: Manufacturer's standard length for number of holders.
- B. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.
 - 1. Drying rod: Stainless steel, 1/4 inch diameter.
 - 2. Hooks: Three, 0.06 inch stainless steel rag hooks at shelf front.
 - 3. Mop/broom holders: Four spring-loaded rubber cam holders at shelf front.
 - 4. Length: Manufacturer's standard length for number of holders/hooks.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Verify that field measurements are as indicated on drawings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 - 1. Grab Bars: As indicated on drawings.
 - 2. Other Accessories: As indicated on drawings.
- D. Mounting Heights and Locations: As required by accessibility regulations and as indicated on drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00
FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.02 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a (Reapproved 2017).
- B. FM (AG) - FM Approval Guide; current edition.
- C. NFPA 10 - Standard for Portable Fire Extinguishers; 2017.
- D. UL (DIR) - Online Certifications Directory; Current Edition.

1.03 FIELD CONDITIONS

- A. Deliver, store, and handle fire protection specialties and related materials using means and methods that will prevent damage, deterioration, or loss.
- B. Deliver components in manufacturer's original packaging, properly labeled for identification.
- C. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Extinguishers - Basis of Bid:
 - 1. JL Industries, Inc.: www.jlindustries.com.
- B. Acceptable Manufacturers:
 - 1. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 2. Potter-Roemer: www.potterroemer.com.
- C. Fire Extinguisher Cabinets and Accessories - Basis of Design:
 - 1. JL Industries, Inc.: www.jlindustries.com.
- D. Acceptable Manufacturers:
 - 1. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 2. Potter-Roemer: www.potterroemer.com.

2.02 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
 - 1. Model: Cosmic Extinguishers: Multi-Purpose Chemical.
 - 2. Stored Pressure Operated: Deep Drawn.
 - 3. Class: A:B:C type.
 - 4. Size: 5 pound.
 - 5. Size and classification as scheduled.
 - 6. Finish: Baked polyester powder coat, Red color.
 - 7. Temperature range: Minus 40 degrees F to 120 degrees F.

2.03 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 requirements for fire resistance rating of walls where being installed.
- B. Fire Rated Cabinet Construction: One-hour fire rated.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
- C. Model: Ambassador Series
- D. Cabinet Configuration: Recessed type.
 - 1. Model Number: 1815-V17
 - 2. Size to accommodate accessories.
 - 3. Exterior nominal dimensions of 10 1/2 inch wide by 24 inch high by 5 1/2 inch deep.
 - 4. Trimless type.
 - 5. Trim: Flat square edge.
 - 6. Lettering: Vertical; White
 - 7. Fire Rated.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with nylon catch. Hinge doors for 180 degree opening with two butt hinge.
- F. Door Glazing: Glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: Baked enamel, Red color.
- J. Finish of Cabinet Interior: White colored enamel.

2.04 ACCESSORIES

- A. Lettering: "FIRE EXTINGUISHER" decal, or vinyl self-adhering, pre-spaced black lettering in accordance with authorities having jurisdiction (AHJ).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.
- C. Examine walls and partitions for suitable framing depth and blocking where recessed and semi-recessed cabinets will be installed, and blocking where surface mounted cabinets will be installed.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets in locations and at mounting heights indicated, or if not indicated, at heights to comply with applicable regulations of governing authorities.
- C. Maintain fire ratings where cabinets are recessed into fire-rated wall systems.
- D. Secure rigidly in place.
- E. Place extinguishers in cabinets.
- F. Position cabinet signage on glass door..

3.03 FIELD QUALITY CONTROL

- A. Ensure that each extinguisher is fully charged, and that inspection of each extinguisher has been performed, as evidenced by the National Association of Fire Equipment Distributors certification tag, just prior to Substantial Completion.

END OF SECTION

SECTION 10 51 00

LOCKERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Phenolic lockers.
- B. Locker benches.

1.02 REFERENCE STANDARDS

- A. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2017.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Phenolic Lockers - Basis of Design:
 - 1. Republic Storage Systems Co; Product: www.republicstorage.com.
- B. Acceptable Manufacturers:
 - 1. Lyon Workspace Products: www.lyonworkspace.com.
 - 2. Penco Products, Inc: www.pencoproducts.com.

2.02 LOCKER APPLICATIONS

- A. Athletic Lockers, in general locker rooms: Z-tier (2 lockers each with a short and long compartment) solid phenolic lockers, wall mounted with matching closed base, free-standing with matching closed base.
 - 1. Width: 12 inches.
 - 2. Depth: 12 inches.
 - 3. Height: 72 inches.
 - 4. Fittings: 2 coat hooks.
 - 5. Locking: Padlock hasps, for padlocks provided by Owner.
 - 6. Provide sloped top.
- B. Athletic Lockers in Team Locker Rooms: Single tier solid phenolic lockers, wall mounted with matching closed base, free-standing with matching closed base.
 - 1. Width: 12 inches.
 - 2. Depth: 12 inches.
 - 3. Height: 72 inches.
 - 4. Fittings: Hat shelf, 2 coat hooks.
 - 5. Locking: Padlock hasps, for padlocks provided by Owner.
 - 6. Provide sloped top.
- C. Locker Benches: Stationary type; bench top of laminated maple; painted steel pedestals.

2.03 PHENOLIC LOCKERS

- A. Lockers: Factory assembled, made of phenolic core panels with mortise and tenon joints and stainless steel mechanical joint fasteners; fully finished inside and out; each locker capable of standing alone.
 - 1. Doors: Full overlay, covering full width and height of locker body; square edges.
 - 2. Panel Core Exposed at Edges: Machine polished, without chips or tool marks; square edge unless otherwise indicated.
 - 3. Where locker ends or sides are exposed, finish the same as fronts or provide extra panels to match fronts.
 - 4. Ventilation: By holes drilled in tops, bottoms, and intermediate shelves, and by open space between the back of door and locker body.

5. Door Color: To be selected by Architect.
 6. Body Color: To be selected by Architect.
 7. Fasteners for Accessories and Locking Mechanisms: Tamperproof type.
- B. Component Thicknesses:
1. Doors: 1/2 inch minimum thickness.
 2. Locker Body: One of the following combinations:
 - a. Tops, bottoms, and shelves 3/8 inch; sides and backs 5/16 inch; minimum.
 - b. Tops, bottoms, and shelves 1/2 inch; sides 3/8 inch; backs 1/4 inch; minimum.
 3. End Panels and Filler Panels: 1/2 inch minimum thickness.
 4. Sloped Tops: 1/2 inch minimum thickness.
 5. Toe Kick Plates: 1/2 inch minimum thickness.
- C. Phenolic Core Panels: Nonporous phenolic resin and paper core formed under high pressure, with natural colored finished edges, integral melamine surface, matte finish, and uniform surface appearance; glued laminated panels not acceptable.
1. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 450 or less; when tested in accordance with ASTM E84.
- D. Hinges: Stainless steel, satin finish; minimum of 90 degree opening; either exposed barrel 5-knuckle hinge attached to back of door and inside of body with tamperproof screws, or completely concealed cabinet style hinge attached with tamperproof screws.
- E. Coat Hooks: Stainless steel; attached with tamperproof screws.
- F. Number Plates: Manufacturer's standard, minimum 4-digit, permanently attached with adhesive; may be field installed.
- G. Locks: Locker manufacturer's standard type of style indicated above.
- H. Lock Strike: Stainless steel strike plate attached to locker body with throughbolts.
- I. Locker Legs: ABS plastic adjustable support and leveling leg, minimum 1 inch adjustment; with hardware for attaching toe kick plates.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install lockers plumb and square.
- C. Place and secure on prepared base.
- D. Secure lockers with anchor devices to suit substrate materials. Minimum Pullout Force: 100 lb.
- E. Bolt adjoining locker units together to provide rigid installation.
- F. Install end panels, filler panels, and sloped tops.
- G. Install accessories.
- H. Replace components that do not operate smoothly.

3.02 CLEANING

- A. Clean locker interiors and exterior surfaces.

END OF SECTION

SECTION 12 24 00
WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Manual roller shades and accessories.

1.02 REFERENCE STANDARDS

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2015.
- C. WCMA A100.1 - Safety of Window Covering Products; 2018.

1.03 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum five years of documented experience with shading systems of similar size, type, and complexity; manufacturer's authorized representative.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.05 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.06 WARRANTY

- A. Provide manufacturer's standard, non-depreciating warranty, for interior shading only, covering the following:
 - 1. Shade Hardware: 10 years unless otherwise indicated.
 - 2. Shade Fabric: 10 years unless otherwise indicated.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design: MechoShade Systems LLC; www.mechoshade.com.

2.02 ROLLER SHADES

- A. General:
 - 1. Provide shade system components that are capable of being removed or adjusted without removing mounted shade brackets or cassette support channel.
 - 2. Provide shade system that operates smoothly when shades are raised or lowered.
- B. Roller Shades - Basis of Design: MechoShade Systems LLC; Eurotwill 6000 Series; www.mechoshade.com.
 - 1. Description: Single roller, manually operated fabric window shades.
 - a. Drop Position: Regular roll.
 - b. Mounting: Window jamb mounted.
 - c. Size: As indicated on drawings.
 - d. Fabric: As indicated on drawings.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Steel, 1/8 inch thick.

3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - d. Roller tubes to be capable of being removed and reinstalled without affecting roller shade limit adjustments.
4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 - a. Provide a permanently lubricated brake assembly mounted on a oil-impregnated hub with wrapped spring clutch.
 - b. Brake must withstand minimum pull force of 50 pounds in the stopped position.
 - c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 pound minimum breaking strength. Provide upper and lower limit stops.
 - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
7. Accessories:
 - a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
 - 1) Fascia to be capable of installation across two or more shade bands in one piece.
 - 2) Provide single fascia to accommodate regular roll shades.
 - 3) Color: As selected by Architect from manufacturer's standard colors..

2.03 SHADE FABRIC

- A. Fabric - Type Eurotwill 6000 Series: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
 1. Performance Requirements:
 - a. Flammability: Pass NFPA 701 large or small scale test.
 - b. Fungal Resistance: No growth when tested according to ASTM G21.
 2. Openness Factor: 3%, nominal.
 3. Color: As selected by Architect from manufacturer's full range of colors.
 4. Products:
 - a. MechoShade Systems LLC Inc; EuroTwill Reversible Weave - 6000 series (3% open): www.mechoshade.com.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 2. Horizontal Dimensions - Inside Mounting: Fill openings from jamb to jamb.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Replace shades that exceed specified dimensional tolerances at no extra cost to Owner.
- C. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.

3.05 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 12 36 00
COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinet work.
- B. Wall-hung counters and vanity tops.

1.02 REFERENCE STANDARDS

- A. ANSI A208.2 - American National Standard for Medium Density Fiberboard for Interior Use; 2009.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2017.
- C. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards, U.S. Version 3.1; 2016, with Errata (2017).
- D. ISFA 2-01 - Classification and Standards for Solid Surfacing Material; 2013.
- E. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material; 2013.
- F. MIA (DSDM) - Dimensional Stone Design Manual, Version VIII; 2016.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- H. PS 1 - Structural Plywood; 2009.
- I. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- J. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- K. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.03 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification:
 - 1. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section:
www.woodworkinstitute.com/#sle.
 - 2. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 3. For projects under OSHPD-1, OSHPD-2, or DSA jurisdiction, comply with WI (CSIP) woodwork association quality certification service/program in accordance with requirements for work specified in this section.
 - 4. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 5. Provide designated labels on shop drawings as required by certification program.
 - 6. Provide designated labels on installed products as required by certification program.
 - 7. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
- C. Source Limitations: Obtain each type of countertops and accessories through one source from a single fabricator.
- D. Coordination:
 - 1. Coordinate fabrication and installation with the work of related trades to ensure that supporting construction conforms to fabricator's tolerance requirements and that necessary rough-in work, backing and anchorage are properly installed.
- E. Sequencing:

1. Deliver countertops to the Project site only after the building has been enclosed with permanent exterior enclosure, and;
 - a. Wet work in storage areas, including but not limited to concrete, plastering, gypsum board finishing, tiling, painting and similar work has been completed and cured or dried to a condition of equilibrium.
 - b. Storage areas have been broom cleaned.
 - c. HVAC system has been activated, operating and maintaining temperature and relative humidity.

1.04 DELIVERY, STORAGE, AND HANDLING

- A. Packaging Requirements:
 1. Store products in manufacturer's unopened packaging until ready for installation.
 2. Mark each item with identification number in distribution and installation.
- B. Delivery Requirements.
 1. Deliver items to Project site in accordance with fabricator requirements or recommendations.
 2. During transport and delivery, protect items from prolonged exposure to UV radiation in excess of fabricator's recommendations. Protect from exposure to weather and or becoming wet or other forms of deterioration or damage.
- C. Acceptance at Site Requirements:
 1. Inspect items for damage.
 2. Reject delivery of items that show damage or have damaged containers.
 3. Unload and store only undamaged items.
- D. Storage and Handling Requirements:
 1. Protect units from moisture damage.
 2. Store countertops in assigned spaces having controlled temperature and relative humidity conforming to the recommendations of WI.
 3. Handle countertops with clean hands.
- E. Waste Management:
 1. Remove and dispose of construction waste at a disposal location away from Project site.
 2. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.05 FIELD CONDITIONS

- A. Existing Conditions:
 1. Field verify measurements before preparing submittals and indicate those dimensions on the shop drawings.
 2. If field measurements cannot be made without delaying the Work, establish working dimensions that accommodate installation tolerances, as well as related tolerances specified in the Work of other Sections. Indicate those working dimensions on the shop drawings.
 3. Coordinate the installation of the adjacent work to ensure the actual dimensions accommodate the previously established working dimensions.
 4. Provide enough additional material during fabrication to allow for proper trimming and fitting at the Project site.
- B. During and after installation of architectural wood casework, maintain temperature and relative humidity conditions in building spaces at same levels planned for occupancy.
- C. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- D. Acclimate casework to specified temperature and relative humidity conditions for at least 72 hours before installation.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Premium Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Solid Surfacing Countertops: Solid surfacing sheet or plastic resin casting self-supporting over structural members.
 - 1. Flat Sheet Thickness: 1/2 inch, minimum.
 - 2. Solid Surfacing Sheet and Plastic Resin Castings: Complying with ISFA 2-01 and NEMA LD 3; acrylic or polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Avonite Surfaces; Surfaces or Studio Collections: www.avonitesurfaces.com.
 - 2) Dupont; Corian: www.corian.com.
 - 3) Formica Corporation; Solid Surfacing: www.formica.com.
 - 4) Wilsonart; Solid Surface Collection: www.wilsonart.com.
 - 5) Or equal.
 - b. NSF approved for food contact.
 - c. Finish on Exposed Surfaces: Matte, gloss rating of 5 to 20.
 - d. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: 1/2 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1 1/2 inch thick; square edge.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.
 - 7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.
- C. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
 - 1. Flat Sheet Thickness: 1-1/4 inch, minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard woodworking tools; no surface coating; color and pattern consistent throughout thickness.
 - a. Manufacturers:
 - 1) Dupont; Zodiaq: www.zodiaq.com.
 - 2) Terrazzo & Marble Supply Companies; DIFINITI Quartz: www.tmsupply.com.
 - 3) Wilsonart; ____: www.wilsonart.com.
 - 4) Or equal.
 - b. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA Dimension Stone Design Manual.
 - c. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - d. NSF approved for food contact.
 - e. Finish on Exposed Surfaces: Polished.
 - f. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: 3/4 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1 1/2 inch thick; square edge.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.
 - 7. Fabricate in accordance with AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS), Section 11 - Countertops, Premium Grade.

2.02 MATERIALS

- A. Wood-Based Components:
 - 1. Wood fabricated from old growth timber is not permitted.
- B. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines. Provide at all sink locations.
- C. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- D. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.
- E. Cove Molding for Top of Splashes: Rubber with semi-gloss finish and T-spline to fit between splash and wall; 1/2 inch by 1/2 inch.
 - 1. Color: As selected by Architect from manufacturer's full line.
- F. Joint Sealant: Mildew-resistant silicone sealant, clear.
- G. Grommets: Standard plastic grommets for cut-outs, in color to blend with adjacent surface.
 - 1. Plastic Grommets:
 - a. Doug Mockett & Company, Inc.; EDP Flip-Top Series: www.mockett.com.
 - b. Hefele; 631.26 Cable Grommet; www.hefele.com.
 - c. Or equal.
 - 2. Style: Round with matching, removable cap.
 - 3. Size: 2 1/2 inch diameter.
 - 4. Provide 1 grommet for each 36" of worksurface unless otherwise indicated on the drawings. To be field located by Architect.
- H. Wall Mounted Counter Support Brackets:
 - 1. Manufacturers:
 - a. Rangine Corporation; RAKKS EH Series Counter Support Bracket: www.rakks.com.
 - b. Chemical Concepts; CounterBalance Concealed Bracket: www.counterbalanceshop.com.
 - c. Or equal.
 - 2. Type: Inside-wall flush mounted.
 - 3. Construction: Fabricated from horizontal aluminum T section and vertical aluminum L section. Vertical leg designed to attach to side of supporting stud and be concealed by gypsum board or other wall finish.
 - 4. Size: As recommended by manufacturer for size of counter indicated on the drawings.
 - 5. Load Capacity per bracket: 400 pounds.
 - 6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter mounted components such as keyboard trays and cable management systems.
 - 7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.
- I. Wall Mounted Vanity Support Brackets:
 - 1. Manufacturers:
 - a. Rangine Corporation; RAKKS EHV Series Vanity Support Bracket: www.rakks.com.
 - b. Chemical Concepts; ADA Vanity Bracket: www.counterbalanceshop.com.
 - c. Or equal.
 - 2. Type: Surface mounted with ADA compliant panel supports.
 - 3. Removeable Panels: Provide removeable panel to conceal piping. Match adjacent casework for panel construction and finish. Provide concealed mounting hardware where available. Where concealed mounting hardware not available from bracket manufacturer, provide Removeable Panel Dismountable Connectors.
 - 4. Size: As recommended by manufacturer for size of vanity indicated on the drawings.
 - 5. Load Capacity per bracket: 400 pounds.

6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter plumbing and components.
 7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.
- J. Removeable Panel Dismountable Connectors: Select type as appropriate for the conditions per manufacturer's recommendation.
1. Product: Z-Clip ZCP manufactured by Mbs Standoffs; <https://mbs-standoffs.com>.
 2. Product: Monarch Z Clips manufactured by Monarch Metal Fabrication; <http://www.monarchmetal.com>.
 3. Product: Suspension Fittings Set manufactured by Richelieu Hardware; <https://www.richelieu.com>.
 4. Product: Striplox Clip Connector System manufactured by Richelieu Hardware; <https://www.richelieu.com>.
 5. Product: Panel Mounting System manufactured by Richelieu Hardware; <https://www.richelieu.com>.
 6. Product: EH Frame Connector & Suspension Fitting manufactured by Hafele America Co.; <https://www.hafele.com>.
 7. Product: Keku Hook-on Hospa/Hospa manufactured by Hafele America Co.; <https://www.hafele.com>.
 8. Or equal
- K. Wall Mounted Bench Support Brackets:
1. Manufacturers:
 - a. Rangine Corporation; RAKKS EHB Series Bench Support Bracket: www.rakks.com.
 - b. Federal Brace; Georgian Wall Mounted Bench Support: www.federalbrace.com
 - c. Or equal.
 2. Type: Inside-wall flush mounted.
 3. Construction: Fabricated from horizontal aluminum T section and vertical aluminum L section. Vertical leg designed to attach to side of supporting stud and be concealed by gypsum board or other wall finish.
 4. Size: As recommended by manufacturer for size of counter indicated on the drawings.
 5. Load Capacity per bracket: 400 pounds.
 6. Spacing and attachment: As recommended by the manufacturer for the size of counter indicated on the drawings. Provide equal and balanced spacing and coordinate locations with under-counter mounted components such as keyboard trays and cable management systems.
 7. Backing: Coordinate stud locations or provide backing as indicated on the drawings.

2.03 FABRICATION

- A. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 - a. Rout a 1/8 inch drip groove at underside of exposed overlapping edges, set back 1/2 inch from face of edge.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- B. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches, unless otherwise indicated.
- C. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.

- D. Wall-Mounted Counters: Provide skirts, aprons, brackets, and braces as indicated on Drawings; .

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Coordinate requirements for stud spacing, backing, and auxiliary structural supports to ensure adequate means for installation and anchorage of support brackets.
- C. Do not begin installation until substrates have been properly prepared.
- D. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- E. Verify that openings are properly framed, are true to line, plumb, square and within allowable tolerances.
- F. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.
- G. Reject work that does not conform to the manufacturer's installation requirements.
- H. Perform or arrange for required remedial work necessary to correct deficient conditions and to conform to fabricator's requirements.

3.02 COORDINATION

- A. Coordinate provision of support brackets with design and fabrication of counter tops, work surfaces, and benches to be supported to ensure compatibility of dimensions and load capacity.
- B. Coordinate installation of support brackets with other trades. Ensure that support brackets are delivered to site and installed in a timely manner.

3.03 PREPARATION

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

3.04 INSTALLATION

- A. Install vanities in accordance with manufacturer's instructions and approved shop drawings
- B. Securely attach countertops to cabinets or supports using concealed fasteners. Make flat surfaces level; shim where required.
- C. Seal joint between back/end splashes and vertical surfaces.
 - 1. Where indicated use rubber cove molding.
 - 2. Where applied cove molding is not indicated use specified sealant.

3.05 TOLERANCES

- A. Variation From Horizontal: 1/8 inch in 10 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.

3.06 CLEANING

- A. Clean countertops surfaces thoroughly.
- B. Clean countertops, shelves, hardware, fittings, and fixtures as required, recommended, approved or accepted by the manufacturer.
- C. Do not use cleaning materials or procedures that could change the appearance of exposed finishes or damage adjacent materials.

- D. Waste Management; After completing the Work, leave work areas free from debris, materials, equipment, and related items.

3.07 PROTECTION

- A. Protect items in place from sources of moisture, corrosion, deterioration, staining or other damage.
- B. Do not use countertop surfaces as work surfaces.
- C. Protect installed products until completion of project.
- D. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 21 00 00 - FIRE SUPPRESSION BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 DESIGN-BUILD SUMMARY OF WORK

- A. Work included in 21 00 00 applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits and incidentals to make fire suppression systems ready for Owner's use for proposed project.

1.02 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete Fire Suppression system for this project.
- B. Alternates to this Document may be offered as a separate proposal.

1.03 DESIGN-BUILD DESIGN APPROACH

- A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by AHJ.
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.04 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere:
 - 1. Contents of Section apply to Division 21, Fire Suppression Specifications.
 - 2. Requirements of Section are a minimum for Division 21, Fire Suppression Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Fire Suppression Design Criteria: Refer to individual Division 21, Fire Suppression Sections for fire suppression system design criteria.
- C. Fire Suppression Equipment: Refer to individual Division 21, Fire Suppression Sections for fire suppression equipment requirements.

1.05 SECTION INCLUDES

- A. Work included in 21 00 00, Fire Suppression Basic Requirements applies to Division 21, Fire Suppression work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of fire protection systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.
 - 3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete Item of work furnished.
 - 4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent," substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted Item.

5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.06 RELATED SECTIONS

- A. Content of Section applies to Division 21, Fire Suppression Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.07 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, individual Division 21, Fire Suppression Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of California:
 - a. CBC - California Building Code
 - b. CEC - California Electrical Code
 - c. CEC T24 - California Energy Code Title 24
 - d. CFC - California Fire Code
 - e. CMC - California Mechanical Code
 - f. CPC - California Plumbing Code
 - g. CSFM - California State Fire Marshal
 - h. DSA - Division of State Architect Regulations and Requirements
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ADA - Americans with Disabilities Act
 3. AHRI - Air-Conditioning Heating & Refrigeration Institute
 4. ANSI - American National Standards Institute
 5. ASCE - American Society of Civil Engineers
 6. ASCE-7 Minimum Design Loads for Buildings and Other Structures
 7. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 8. ASHRAE Guideline 0, the Commissioning Process
 9. ASME - American Society of Mechanical Engineers
 10. ASPE - American Society of Plumbing Engineers
 11. ASSE - American Society of Sanitary Engineering
 12. ASTM - ASTM International
 13. AWWA - American Water Works Association
 14. CFR - Code of Federal Regulations
 15. EPA - Environmental Protection Agency
 16. ETL - Electrical Testing Laboratories
 17. FCC - Federal Communications Commission
 18. FM - FM Global
 19. FM Global - FM Global Approval Guide
 20. IAPMO - International Association of Plumbing and Mechanical Officials

21. ICC - International Code Council
22. IEC - International Electrotechnical Commission
23. ICC-ESR - International Code Council Evaluation Service Reports
24. HI - Hydraulic Institute Standards
25. ISO - International Organization for Standardization
26. MSS - Manufacturers Standardization Society
27. NEC - National Electric Code
28. NEMA - National Electrical Manufacturers Association
29. NFPA - National Fire Protection Association:
 - a. NFPA 13 - Standard for the Installation of Sprinkler Systems
 - b. NFPA 25 - Standard for Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems
 - c. NFPA 70 - National Electrical Code
 - d. NFPA 72 - National Fire Alarm and Signaling Code
30. NRCA - National Roofing Contractors Association
31. NSF - National Sanitation Foundation
32. OSHA - Occupational Safety and Health Administration
33. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
34. TIMA - Thermal Insulation Manufacturers Association
35. UL - Underwriters Laboratories Inc.

D. See Division 21, Fire Suppression individual Sections for additional references.

1.08 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 21, Fire Suppression sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
- D. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
- E. Submit shop drawings, calculations and product data sheets as one complete stand-alone package to AHJ, Owner's insurance underwriter and Engineer.
- F. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 21, Fire Suppression Sections.
- G. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.
 1. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed Item. Highlight connections by/to other trades.

2. Include technical data, installation instructions and dimensioned drawings for products, equipment and devices installed, furnished or provided. Reference Division 21, Fire Suppression specification Sections for specific Item required in product data submittal outside of these requirements.
 3. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 4. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
 5. See Division 21, Fire Suppression Sections for additional submittal requirements outside of these requirements.
- H. Maximum of two reviews provided of complete submittal package. Arrange for additional reviews and/or early review of long-lead Item; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
- I. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
- J. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
- K. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 21, Fire Suppression coordination documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical and Division 28, Electronic Safety and Security submittals.
- L. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
- M. Substitutions and Variation from Basis of Design:
1. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 2. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
- N. Shop Drawings:
1. Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout, pipe layout, hanger layout, sway brace layout, seismic restraints, sway brace calculations, drains, location of drain discharge, risers, valves, details, water test information, physical device layout plans, and control wiring diagrams. Reference individual Division 21, Fire Suppression Sections for additional requirements for shop drawings outside of these requirements.

2. Shop Drawings and hydraulics calculations, sway brace calculations, trapeze hanger calculations, and the like, to be prepared under the direct supervision and control of a Professional Engineer competent to do such work and licensed in the state of California. Drawings and calculations to bear the seal and wet signature of the professional Engineer.
 3. Provide Shop Drawings which indicate information required by NFPA 13. Include room names and fire sprinkler occupancy hazard classifications.
 4. Provide Shop Drawings illustrating information for Hydraulic Information Sign for each hydraulic remote area calculated.
 5. Utilizing the Reflected Ceiling backgrounds, provide Shop Drawings illustrating locations of fire sprinklers and piping.
 6. Utilizing the Structural backgrounds, provide Shop Drawings illustrating locations and types of hangers and sway braces.
 7. Provide Shop Drawings illustrating each type of hanger, including fasteners to structure.
 8. Provide Shop Drawings illustrating each type of branchline restraint and sway brace, including length of sway brace member, sway brace fittings, minimum and maximum angles from vertical of sway brace member, method of attachment to structure, size, length and embedment of attachment to structure and size and type of structural member to which sway brace will be attached. Number each type of restraint and sway brace. Indicate on Drawings locations of each type of numbered restraint and sway brace.
 9. Provide details for any hanger, attachment, or sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the engineered product manufacturer.
 10. Provide Shop Drawings illustrating information for Sprinkler System General Information Sign.
 11. Shop Drawings to include a cross-sectional view that shows the sprinkler heads and piping in relation to the building's architectural and structural information. View to be chosen based on a location that will display the most information.
 12. When required, provide Coordination Drawings.
 13. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
 14. Provide details of hanger, sway bracing and branch line restraint attachments to structure and to piping. Include details on the size and load capacities of fasteners. Provide verification of the structural capacity to withstand seismic load.
 15. Provide sway bracing calculations on drawings showing horizontal seismic design load and requirements, with indication of zone of influence for each bracing location.
 16. Provide a schedule of sway bracing type, size, and design criteria, including length, angle from vertical, and load capacities.
 17. Clearly indicate the elevation of the highest sprinkler in relation to the elevation of the flow test pressure gauge monitor hydrant.
 18. Provide details of flexible sprinkler hose fitting per manufacturer's schedule of equivalent feet used in hydraulic calculations, showing device length, maximum number of 90-degree bends and expected radius of bends.
 19. Provide a schedule of signage to be installed at each flexible sprinkler hose fitting.
 20. On the drawings, provide a list of number, model, temperature, sprinkler Identification number, manufacturer, orifice, deflector type, thermal sensitivity and pressure rating, quantity of each type to be contained in the spare sprinkler cabinet and the issue date or revision date of the list."
 21. Spare sprinkler head cabinet size indicating the number of spare sprinkler head to be contained therein.
- O. Samples: Provide samples when requested by individual Sections.
- P. Resubmission Requirements:
1. Make any corrections or change in submittals when required. Provide submittals as specified. The Engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s)

changed and reference response to comment. Clearly indicate changes on Drawings and cloud changes in the submittals.

2. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".

Q. Operation and Maintenance Manuals/Owner's Instructions:

1. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or Item requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - a. Include copies of certificates of code authority acceptance, code-required acceptance tests; test reports and certificates.
 - b. Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Sections.
 - c. Catalog description of each Item of equipment actually installed on job.
 - d. Instructions for operation and maintenance of fire suppression systems composed of operating instructions, maintenance instructions and manufacturer's literature as follows:
 - 1) Testing and Maintenance Schedule Chart: Provide an 8-1/2- by 11-inch typewritten list of each item of installed equipment requiring testing inspection , lubrication or service, describing and scheduling performance of maintenance.
 - 2) Manufacturer's Literature: Provide copies of manufacturer's instructions for operation and maintenance of fire suppression equipment, including replacement parts list with name and address of nearest distributor. Mark each copy with equipment identification label as listed in equipment schedule, i.e. F-5 etc.
 - e. Include product certificates of warranties and guarantees.
 - f. Include Record Drawings,
 - g. Include copy of water supply flow test used as basis for hydraulic calculations.
 - h. Include hydraulic calculations and sway brace calculations.
 - i. Include Contractor's Material and Test Certificates for Aboveground Piping/Underground Piping.
 - j. Include a copy of NFPA 25.
 - k. Include a copy of valve charts and whether normally open or normally closed.
 - l. Include a copy of drain, auxiliary, and low point drains charts.
 - m. Include a copy of the list to be included in the spare sprinkler head box.
 - n. Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - o. Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, and quantities relevant to each piece of equipment: i.e. belts, motors, lubricants, and filters.
 - p. Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
 - q. Include copy of startup and test reports specific to each piece of equipment.
 - r. Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.

2. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 21 00 00, Fire Suppression Basic Requirements, Article titled "Demonstration".
 3. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
- R. Record Drawings:
1. Maintain at site at least one set of Drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical Item. Include items changed by field orders, supplemental instructions, and constructed conditions.
 2. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 3. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
 4. Invert elevations and dimensioned locations for water services and drainage piping below grade extending to 5-feet outside building line.
 5. Record Drawings to include site information or reference site information for complete understanding of the fire protection system between the building and the point of connection to the water supply and location of flow test pressure hydrants.
 6. See Division 21, Fire Suppression individual Sections for additional items to include in Record Drawings.
- S. Calculations: Submit hydraulic and sway brace and the like calculations.
1. Hydraulic Calculations:
 - a. Include friction losses between the hydraulically most remote design area and the hydrant flow test pressure hydrant.
 - b. Hydraulic calculations to be performed on a nationally recognized fire sprinkler hydraulic calculation computer program, with cover sheets in the format required by the latest edition of NFPA 13. Hydraulic calculations performed "by hand" or not on a nationally recognized fire sprinkler hydraulic calculations computer program will be returned without review by engineer.
 - c. Provide one or more hydraulic calculations for each hydraulically most remote area.
 - d. Where it is not obvious which area is most hydraulically remote, perform and submit for review additional hydraulic calculations proving the hydraulically most remote area.
 - e. For grid systems, either provide "peaked" hydraulic calculations, or provide two additional sets of hydraulic calculations for each hydraulically most remote area.
 - f. Include pressure losses between the highest sprinkler and the elevation of the pressure gauge monitor hydrant of the flow test.
 - g. Include friction loss for flexible branch line connectors per manufacturer's schedule of equivalent feet for device length, maximum number of bends and expected radius of bends.
 - h. When flexible sprinkler hose fittings are added to an existing system, provide hydraulic calculations verifying the design flow rate will be achieved."
 - i. For Future Tenant Improvement Spaces: Include in hydraulic calculations friction loss allowances for future installation of flexible sprinkler head connectors so that flexible connectors may be installed in the future without revisions to the overhead system.
 2. Sway Brace Calculations:
 - a. Sway brace calculations utilizing a proprietary computer calculation program only used for the sway brace components supported by that manufacturer. For example, only "manufacturer X" sway brace components, and not those of another

manufacturer, may be calculated on a "manufacturer X" sway brace computer calculation program.

- b. Provide seismic calculations for any sway brace to be attached to any I-joist, structural insulated panels (SIPs), cross laminated timber, and similar engineered structural products according to the specifications of the I-joist manufacturer.

1.09 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, fire alarm, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including fire alarm ceiling suspension and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, and finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in the event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.

- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to sprinkler heads, pipe, fittings, hangers and bracing materials.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL, ETL, FM, ICC-ES, and CSFM approved for their intended fire protection function or have adequate approval or be acceptable by State, County, and City authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Install equipment requiring access (i.e. drains, control operators, valves, motors, engines, pumps, controllers, air compressors, gauges, fill cups, tanks, cleanouts and the like) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions specified. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.

- E. Firestopping:
 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection.
 2. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM International E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating coordinating installation of piping systems.
 2. Include provisions for servicing and removal of equipment without dismantling piping.
- G. Plenums: Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.02 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, and individual Division 21, Fire Suppression Sections.
- B. Provide fire suppression equipment and piping, both hanging and base mounted, with mounting connection points of sufficient strength to resist lateral seismic forces equal to lateral seismic forces as determined by building code and NFPA 13 calculations, whichever is more demanding.
- C. See Structural Drawings for seismic design criteria for sway bracing and seismic restraint.
- D. Earthquake resistant designs for Fire Protection (Division 21) equipment and distribution, i.e. fire sprinkler systems, fire standpipe systems, fire pumps, fire pump controllers, fire tanks, clean agent fire suppression systems, etc. to conform to regulations of jurisdiction having authority.
- E. Restraints which are used to prevent disruption of function of piece of equipment because of application of horizontal force to be such that forces are carried to frame of structure in such a way that frame will not be deflected when apparatus is attached to a mounting base and equipment pad, or to structure in normal way, utilizing attachments provided. Secure equipment and distribution systems to withstand a force in direction equal to value defined by jurisdiction having authority.
- F. Provide stamped Shop Drawings from licensed Engineer of seismic bracing and seismic movement assemblies for piping, equipment, tanks, pumps controllers and the like. Submit shop drawings along with equipment submittals.
- G. Provide stamped Shop Drawings from licensed Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details.
- H. Provide details of flexible drops for sprinklers in conformance with Building Code and ASCE 7 requirements of ceilings. Coordinate with Architectural and Structural Drawings and Specifications.
- I. Piping: Per NFPA 13, ASCE-7 and local requirements.
- J. Equipment:
 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA, ASCE 7 and local requirements.

2. Provide means to prohibit excessive motion of fire protection equipment during an earthquake.

3.03 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 1. Underground piping installation prior to backfilling.
 2. Prior to covering walls.
 3. Prior to ceiling cover/installation.
 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
 5. When mains or branchlines are to be permanently concealed by construction or insulation systems.
 6. When fire suppression systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.
- D. Final Punch: Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
 1. Cutting and patching performed under Division 21, Fire Suppression includes, but is not limited to:
 - a. Cutting and patching of plaster or partitions.
 - b. Cutting and patching of finished ceilings.
 2. Perform cutting and patching by skilled craftsmen in trade of work to be performed. Fill holes which are cut oversized for completed work. Match refinished areas with existing adjacent finish in a manner acceptable to Architect.
 3. When masonry to concrete construction must be penetrated, provide a steel pipe sleeve in opening and grout in place in a neat manner. Leave grout surface to match existing finish. Provide escutcheons. If sleeves are not provided, core drill penetrations.
 4. Locate concealed utilities to eliminate possible service interruption or damage.
 5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.
 6. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 7. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
 8. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.

9. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, landscaping, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
10. Repair mutilation of building around pipes, equipment, hangers, and braces.

3.05 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing at no additional cost to Owner.

3.06 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage and deterioration. Store materials in original containers which identify manufacturer, name, brand and model numbers on site inside building or protected from weather, sun, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar Item until in service.

3.07 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.
- D. Prior to acceptance of work and during time designated by Architect, provide necessary qualified personnel to operate system for a period of two hours.
- E. Instruct the Owner in the operation of the sprinkler system, including main valve position (open or closed) recognition, system drainage, system testing, dry pipe valve reset and the relation to the fire alarm system.
- F. Upon completion of work and adjustment of equipment, test systems to demonstrate to Owner's Authorized Representative and Architect that equipment is furnished and installed or connected under provisions of these Specifications.

3.08 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.

- B. Upon completion of installation, except for sprinklers, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.
- C. Sprinklers may not be cleaned except for vacuuming in a manner in which no part of the sprinkler is touched by the vacuuming equipment. Replace sprinklers which bear traces of foreign substances with sprinklers of same model, temperature, K-factor, orifice, finish, style, orientation, and the like.

3.09 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Install equipment in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start-up equipment, in accordance with manufacturer's start-up instructions, in the presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.10 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
 - 1. Ferrous Metal: After completion of fire protection work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. After acceptance by Authority Having Jurisdiction (AHJ), in a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 4. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 5. Covers: Covers such as vault covers and the like will be furnished with finishes which resist corrosion and rust.

3.11 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 21, Fire Suppression and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing reports including Contractor's Material and Test Certificate for Underground Piping, Contractor's Material and Test Certificate for Aboveground Piping, Contractor's Material and Test Certificate for Private Fire Service Mains, Fire pump acceptance test data report, and the like.
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings

- f. Warranty and Guaranty Certificates
- g. Start-up/Test Document and Commissioning Reports
- h. Letter of Conformance

3.12 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Upon completion of installation of equipment, sprinklers, hose valves and piping and after units are water pressurized, test system to demonstrate capability and compliance with requirements. When possible, correct malfunctioning Item at site, then retest to demonstrate compliance; otherwise remove and replace with new Item and proceed with retesting.
- C. Inspect each installed Item for damage to finish. If feasible, restore and match finish to original, except fire sprinklers, at site; otherwise, remove Item and replace with new Item. Feasibility and match to be judged by Architect. Remove cracked or dented Item and replace with new Item.
- D. Fire sprinklers may not be reused, or cleaned, except for dusting. Replace damaged, field painted, oversprayed, overcoated or field coated sprinklers with new sprinklers of same manufacturer, model, finish, K-factor and performance characteristics. Where identical replacement sprinklers are not available, provide sprinklers of similar finish, style, K-factor and performance characteristics.

3.13 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance and copies of manufacturers' warranties and extended warranties with a statement that fire suppression items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.14 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize fire protection equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.15 CONNECTIONS TO EXISTING

- A. Prior to connection of piping to existing piping or utilities, field verify existing conditions and exact sizes and locations of existing piping. Provide additional offsets, transitions, joints, cut-ins, and replace portions of existing as required to facilitate connections of new.

END OF SECTION

SECTION 21 05 00 - COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Aboveground Black Steel Pipe and Fittings
 - 2. Wall and Floor Penetrations and Sleeves
 - 3. Switches, Valve Supervisory
 - 4. Switches, Water Detector
 - 5. Hangers and Supports
 - 6. Struts and Strut Clamps
 - 7. Sway Braces and Restraints
 - 8. Anchors and Attachments
 - 9. Pipe Stands
 - 10. Gauges
 - 11. Valves
 - 12. Pipe, Valve, and Fire Protection Equipment Identification
 - 13. Signs
 - 14. Drains

1.02 RELATED SECTIONS

- A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 22, Plumbing
 - 2. Division 23, Heating, Ventilating and Air Conditioning
 - 3. Division 26, Electrical
 - 4. Division 28, Electronic Safety and Security
 - 5. Division 31, Earthwork
 - 6. Section 21 00 00, Fire Suppression Basic Requirements
 - 7. Section 21 13 00, Fire Suppression Sprinkler Systems

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. Meet requirements of ASCE 7, Minimum Design Loads for Buildings and Other Structures, by American Society of Civil Engineers, latest adopted edition.

1.04 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Material and Equipment: Listed for its intended fire protection use in current UL Fire Protection Equipment Directory, or UL Online Certifications Directory for Fire Protection, International Code Council Evaluation Service Reports, or FM Global Approval Guide. All material and equipment to be new and from a current manufacturer.
 - 2. Provide per AHJ requirements.
 - 3. References to product Specifications for materials are listed according to accepted ANSI, ASTM, ASME, AWWA and other base standards. Materials to meet latest approved versions of these standards.

4. Fire Suppression Screw-Thread Connections: Comply with local fire department/fire marshal regulations for sizes, threading and arrangement of connections for fire department equipment to fire department connections.
5. Manufacturers: Unless an item is marked "No substitutions", submit substitution request for materials of other than named manufacturers.
6. Noise and Vibration:
 - a. Install vibration isolators and measures required to prevent noise and vibration from being transmitted to occupied areas. Select equipment to operate within noise coefficient (NC) design level for particular type of installation in relation to its location.
 - b. After installation, make proper adjustments to reduce noise and vibration to acceptable levels as defined by Architect.
 - c. In acoustically sensitive areas, design system in a manner that minimizes the number of wall penetrations.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.07 FLOW TEST

- A. Provide materials and labor for a new water supply test on the closest nearby fire hydrants per NFPA 13 and NFPA 291. Base hydraulic calculations on new flow test.

1.08 SYSTEM IMPAIRMENT

- A. When returning a water-based fire protection system to service after impairment or control valve closure, verify the system is in working order by performing a main drain test per NFPA 25.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Aboveground Black Steel Pipe and Fittings:
 1. Pipe:
 - a. Bull Moose Tube
 - b. Wheatland Tube Company
 - c. Youngstown Tube Company
 - d. Tex-Tube Company
 - e. State Pipe and Supply, Incorporated
 - f. Or approved equivalent
 2. Fittings, Mechanical and Grooved Couplings:
 - a. Victaulic
 - b. Gruvlok
 - c. Shurjoint Piping Products Incorporated
 - d. Smith-Cooper International
 - e. Tyco Fire & Building Products
 - f. Viking Corporation
 - g. Allied Rubber and Gasket Company Incorporated, dba ARGCO
 - h. Anvil International
 - i. Dixon Valve & Coupling
 - j. Or approved equivalent.
 3. Fittings, Threaded:
 - a. Ward Manufacturing
 - b. Anvil International
 - c. Smith-Cooper International
 - d. Aegis Technologies
 - e. Or approved equivalent.
 4. Fittings, Rubber Gasketed:
 - a. Victaulic

- b. Anvil International
 - c. AnvilStar
 - d. EBAA Iron, Incorporated
 - e. Shurjoint Piping Products, Incorporated
 - f. Smith-Cooper International
 - g. Tyco Fire & Building Products
 - h. Viking Corporation
 - i. Ward Manufacturing
 - j. Allied Rubber and Gasket Company Incorporated, dba ARGCO
 - k. Dixon Valve & Coupling
 - l. Or approved equivalent.
5. Fittings, Welded:
- a. Anvil International
 - b. Shurjoint Piping Products Incorporated
 - c. Smith-Cooper International
 - d. State Pipe & Supply, Incorporated
 - e. Or approved equivalent.
6. Fittings, Flanged:
- a. Victaulic; Groove/Flange Adapter.
 - b. United Brand Fittings
 - c. U.S. Pipe
 - d. Anvil S.P.F.
 - e. Iowa Fittings Company
 - f. Tyco Fire Products; Grinnell Groove/Flange Adapter
 - g. Or approved equivalent.
- B. Wall and Floor Penetrations and Sleeves:
- 1. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 2. Fire Protection Products Incorporated (FPPI)
 - 3. Or approved equivalent.
- C. Switches, Valve Supervisory:
- 1. Outside Screw and Yoke Valve Supervisory Switch:
 - a. Potter Electric Signal Company; Model OSYSU-1, -2.
 - b. System Sensor; Model OSY2 or OSYECF.
 - c. Or approved equivalent.
 - 2. Post Indicator Valve (PIV) Control Valve Supervisory Switch:
 - a. Potter Electric Signal Company; Model PCVS-1, -2.
 - b. System Sensor; Model PIVB2 or PIVBEXP.
 - c. Or approved equivalent.
 - 3. Non-Rising Stem Valve Supervisory Switch:
 - a. Potter Electric Signal Company; Model PTS-C.
 - b. System Sensor; Model PSP1.
 - c. Or approved equivalent.
 - 4. Ball Valve Supervisory Switch:
 - a. Potter Electric Signal Company; Model RBVS.
 - b. System Sensor; Model PSP1.
 - c. Or approved equivalent.
 - 5. Angle Valve Supervisory Switch:
 - a. System Sensor; Model PSP1.
 - b. Or approved equivalent.
- D. Switches, Water Detector:
- 1. Water Flow Switches:
 - a. Wet Sprinkler Systems:

- 1) Potter Electric Signal Company; Model VSR.
- 2) System Sensor; Model WFD.
- 3) Or approved equivalent.

E. Hangers and Supports:

1. Cooper B-Line Tolco:
 - a. Ring Hangers: Figure 200.
 - b. U-Bolts: Model B3188.
 - c. Straps:
 - 1) Figure 22.
 - 2) Figure 22L2.
 - 3) Figure 23.
 - 4) Figure 24.
 - 5) Figure 28.
 - 6) Figure 29.
 - 7) Model B3184.
 - d. Riser Clamps: Model B3373.
 - e. Pipe Clamps: Model B3140, Figure 4B.
2. Anvil International
3. ITW Buildex Sammys
4. Erico International
5. PHD Manufacturing Incorporated
6. Or approved equivalent.

F. Struts and Strut Clamps:

1. Struts:
 - a. Cooper B-Line Tolco
 - b. Or approved equivalent.
2. Strut Clamps:
 - a. Cooper B-Line Tolco; Model B2400.
 - b. Or approved equivalent.

G. Sway Braces and Restraints:

1. Cooper B-Line Tolco:
 - a. Fig. 75
 - b. Fig. 4A
 - c. Fig. 4L
 - d. Fig. 4LA
 - e. Fig. 800
 - f. Fig. 825
 - g. Fig. 825A
 - h. Fig. 828
 - i. Fig. 906
 - j. Fig. 910
 - k. Fig. 975
 - l. Fig. 980
 - m. Fig. 1000
 - n. Fig. 1001
 - o. Fig. 2002
2. Anvil International
3. Erico International
4. PHD Manufacturing Incorporated
5. Or approved equivalent.

H. Anchors and Attachments:

1. Concrete:

- a. Cast-In Place Anchors for Hangers:
 - 1) Cooper B-Line Tolco; Models 109, 109AF, B2500 with N2500 nut, or B3014 with B3014N nut.
 - 2) Erico International
 - 3) Or approved equivalent.
 - b. Cast-In Place Anchors for Braces:
 - 1) Cooper B-Line Tolco; Models B2500 with N2500 nut, or B3014 with B3014N nut.
 - 2) Anvil International; Figure 282 with nut.
 - 3) Erico International
 - 4) Or approved equivalent.
 - c. Attachments as specified or described by structural. If not specified or described by structural, then as follows:
 - 1) Hilti; Model Kwikbolt TZ
 - 2) Powers; Models Snake+, Power Stud+ SD2, or Powers Wedge-Bolt.
 - 3) Simpson Strong-Tie
 - 4) DeWalt; Mini-Undercut+, internally threaded undercut anchor.
 - 5) Or approved equivalent.
2. Wood:
- a. Cooper B-Line Tolco:
 - 1) Fig. 50
 - 2) Fig. 51
 - 3) Fig. 56
 - 4) Fig. 58
 - 5) Fig. 78
 - 6) Fig. 120
 - 7) Fig. 130
 - b. Anvil International
 - c. Elco Construction Products, Hangermate
 - d. Erico International
 - e. ITW Buildex Sammays
 - f. Or approved equivalent.
3. Steel:
- a. Cooper B-Line Tolco:
 - 1) Model B3037
 - 2) Model B3033
 - 3) Model B3034
 - 4) Fig. 65
 - 5) Fig. 66
 - 6) Fig. 67
 - 7) Fig. 68
 - 8) Fig. 69
 - 9) Model B3042T
 - 10) Fig. 22L2
 - 11) Fig. 23
 - 12) Fig. 24
 - 13) Fig. 28
 - 14) Fig. 78
 - b. Anvil International
 - c. Elco Construction Products, Hangermate
 - d. Erico International
 - e. ITW Buildex Sammays
 - f. Or approved equivalent.

I. Pipe Stands:

1. Cooper B-Line Tolco; Fig B3092 with Fig. B3088ST.
 2. Anvil International; Figure 259 with Figure 62 or 63.
 3. Or approved equivalent.
- J. Gauges:
1. Ashcroft; Model 105P-XUL.
 2. US Gauge; Model 1590K.
 3. Brecco
 4. Reliable Automatic Sprinkler Company
 5. Fire Protection Products, Incorporated (FPPI)
 6. Allied Rubber and Gasket Company Incorporated, dba ARGCO
 7. Wika Instrument Corporation
 8. Or approved equivalent.
- K. Valves:
1. OS&Y Gate:
 - a. 175 PSI:
 - 1) Nibco; Model F-607-0.
 - 2) Mueller; Model R-2360-6.
 - 3) Or approved equivalent.
 - b. 250 PSI:
 - 1) Victaulic; Model 771.
 - 2) Or approved equivalent.
 - c. 350 PSI:
 - 1) Nibco; Model F697-0.
 - 2) Or approved equivalent.
 - d. 2-inches and Smaller:
 - 1) Nibco; Model T-104.
 - 2) Or approved equivalent.
 2. NRS Gate:
 - a. 175 PSI:
 - 1) Nibco M/F-609 with Nibco NIP1A for yard use.
 - 2) Nibco M/F-609 with Nibco NIP2A for wall use.
 - 3) Or approved equivalent.
 - b. 200 PSI:
 - 1) Mueller A-2361 with Mueller A-2080x indicator post for yard use.
 - 2) Mueller A-2361 with Mueller A-20813 wall type indicator post for wall use.
 - 3) Or approved equivalent.
 - c. 250 PSI:
 - 1) Victaulic; Model 772, with Model 774 indicator post for yard use.
 - 2) Victaulic; Model 772, with Model 773 wall type indicator post for wall use.
 - 3) Or approved equivalent.
 3. Swing Check:
 - a. Victaulic; Model 717.
 - b. Nibco; Model F-908-W.
 - c. Mueller; Model A-2122-6.
 - d. Viking Easy Riser Swing Check.
 - e. Tyco; Model CV-1F.
 - f. AnvilStar; Series 78FP.
 - g. Reliable; Model G.
 - h. Or approved equivalent.
 4. Wafer Check:
 - a. Nibco; Model W-900-W.
 - b. Mueller; Model A2102.

- c. Viking
- d. Tyco
- e. Or approved equivalent.
- 5. Butterfly Valves:
 - a. Victaulic; Series 705, Series 707, Series 765, Series 766.
 - b. Nibco; Model WD3510-8.
 - c. Tyco; Model BFV-N.
 - d. Use lug body next to pumps; Nibco; Model LD-3510-6.
 - e. Reliable; Model REL-BFG-300-I.
 - f. Or approved equivalent.
- 6. Pressure Relief:
 - a. Watts; Model FP-53L.
 - b. United Brass Works; Model 132.
 - c. AGF
 - d. Or approved equivalent.
- 7. Automatic Ball Drip Drain Valve:
 - a. Tyco; Model AD-1,-2.
 - b. Reliable Automatic Sprinkler Company
 - c. Or approved equivalent.
- 8. Three-Way Gauge Valve:
 - a. Fire Protection Products Incorporated (FPPI); 1/4-inch IPS, UL/ULC Listed, 300 psi.
 - b. AGF Manufacturing Inc.; Model 7600, 1/4-inch 3-Way Globe Valve.
 - c. Nibco; 400 PSI WWP Bronze Side Outlet Globe Valve KT-291-W3.
 - d. Or approved equivalent.
- 9. Automatic Air Release Valve:
 - a. Potter Electric Signal Company
 - b. Or approved equivalent.
- 10. Ball Valve:
 - a. Victaulic; Series 728.
 - b. Apollo Valves; 64 Series, 1/4-inch through 2-inches.
 - c. Fire Protection Products Incorporated (FPPI)
 - d. Nibco; Models KX-505-W-8, KT-580-70-UL, or KT-585-70-UL.
 - e. Or approved equivalent.
- L. Pipe, Valve, and Fire Protection Equipment Identification:
 - 1. Fire Protection Products, Incorporated (FPPI)
 - 2. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 3. Or approved equivalent.
- M. Signs:
 - 1. Tyco Fire Products
 - 2. Reliable Automatic Sprinkler
 - 3. Viking Corporation
 - 4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 5. Or approved equivalent.
- N. Drains:
 - 1. Reference Aboveground Black Steel Pipe and Fittings.
 - 2. AGF
 - 3. Victaulic
 - 4. Or approved equivalent.

2.02 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

- A. Wet Pipe Systems:

1. Pipe Size 2-inch Diameter and Smaller: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 40 when installed with threaded fittings; minimum of schedule 10 when installed with grooved fittings.
 2. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 10.
 3. Exposed pipe 8-feet or less above finished floor: A minimum of Schedule 40.
- B. Joints:
1. Threaded, flanged or bevel welded.
 2. Piping installed in plenums or shafts to have welded joints.
- C. Fittings:
1. Threaded:
 - a. Malleable Iron: Class 150 and Class 300, ANSI B16.3.
 - b. Cast Iron: Class 125 and 250, ANSI B16.3.
 2. Flanged:
 - a. Cast iron; Class 125 and 250, ASME B16.1.
 - b. Raised ground face, bolt holes spot faced.
 3. Welded:
 - a. Carbon Steel: Long radius, standard weight or extra strong.
 - b. Factory Wrought Steel Buttweld Fittings: ASME B16.9.
 - c. Buttwelding Ends for Pipe, Valves, Flanges and Fittings: ASME B16.25.
 - d. Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures: ASTM A234.
 - e. Steel Pipe Flanges and Flanged Fittings: ASME B16.5.
 - f. Forged Steel Fittings, Socket Welded and Threaded: ASME B16.11.
 4. Mechanical Fittings and Grooved Couplings:
 - a. Couplings: UL 213, AWWA C606, ASTM A536 ductile iron or ASTM A47 malleable iron, with enamel finish and grooves or shoulders designed to accept grooved couplings. Synthetic-rubber gasket with central-cavity, pressure-responsive design and ASTM A183 carbon-steel bolts and nuts.
 - b. FM Global approved.
- D. Anti-Microbial Coating: Factory-applied coating to inhibit corrosion from microbiological organisms.

2.03 WALL AND FLOOR PENETRATIONS AND SLEEVES

- A. Below Grade and High Water Table Areas: Waterproof elastomeric compound.

2.04 SWITCHES, VALVE SUPERVISORY

- A. Provide to mount on applicable, compatible valve (OS&Y gate, or PIV), with SPDT switches to match requirements of fire alarm system. Provide with cover tamper switch where required by AHJ.

2.05 SWITCHES, WATER DETECTOR

- A. Provide with cover tamper switch where required by AHJ.
- B. Water Flow Switches:
1. Vane-type; SPDT switches; electronic retard, adjustable time delay (0 to 75 seconds).
 2. Wet Sprinkler Systems, NFPA 13: 450 PSI, 18-feet per second, 4-10 gpm.
- C. Pressure Operated Alarm Switches: Pressure actuated with SPDT electrical switches and adjustable time delay (0 to 75 seconds).

2.06 HANGERS AND SUPPORTS

- A. General: Select size of hangers and supports to exactly fit pipe size for bare piping.
- B. Hangers: Ferrous.
- C. Hanger Rods: Zinc electroplated carbon steel.

- D. Finishes: Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- E. Materials:
 - 1. Use carbon steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
 - 2. Use stainless steel hangers, rods and attachments for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.
- F. Anti-Scratch Padding: Use padded hangers for piping subject to scratching.

2.07 STRUTS AND STRUT CLAMPS

- A. Electro-galvanized steel.
- B. Designed for supporting pipe runs from strut supports.
- C. Strut clamps UL listed for fire protection.
- D. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries and the like.

2.08 SWAY BRACES AND RESTRAINTS

- A. Sway Bracing: From a single manufacturer and compatible with sway brace calculation program.
- B. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.

2.09 ANCHORS AND ATTACHMENTS

- A. General: Anchor supports to masonry, concrete and block walls per anchoring system manufacturer's recommendations, or as modified by project Structural Engineer.
- B. Materials:
 - 1. Ferrous.
 - 2. Stainless steel for corrosive environment applications. Examples of corrosive environment applications include, but are not limited to: swimming pools and spas, pool and spa equipment rooms and adjacent areas, chemical rooms, kidney dialysis areas, marine and beach environments, commercial laundries, and the like.
- C. Cast in Place Anchors for Hangers: Verify listing is for hangers, braces, or both.
- D. Attachments in Concrete:
 - 1. Suitable for hanging and bracing fire protection systems in concrete which is subject to cracking in a seismic event.
 - 2. Seismic Design Areas C, D, E and F:
 - a. Compatible with International Code Council Evaluation Service Acceptance Criteria AC-193 and AC308 for expansion, screw and adhesive anchors. Meet requirements of ACI 355.2, Qualification of Post-Installed Mechanical Anchors in Concrete and Commentary.
 - b. All models of Hilti HDI and ITW Red Head Multi-Set II anchors are not approved for attaching fire protection systems in Seismic Design Areas C, D, E and F. No Exceptions.
- E. ITW Buildex Sammys with FM Approval only are not allowed in certain seismic zones. Verify with FM that FM Approval is effective in project's seismic zone.

2.10 PIPE STANDS

- A. Adjustable Pipe Saddle Support with Yoke:
 - 1. Designed to support horizontal pipe from floor stanchion.
 - 2. U-bolt and hex nuts to hold pipe securely to saddle or pipe clamp type.
 - 3. ANSI/MSS SP-69; SP-58. Type 37.
 - 4. Steel pipe with steel saddle.
- B. Base Stand:
 - 1. Steel pipe welded to steel base plate.
 - 2. Meet requirements of 12X anchor diameter hole spacing for seismic applications.

2.11 GAUGES

- A. Pressure Gauges: 3.5-inch, dial type, bronze bourdon tube or spring type, stainless steel case. 0 to 300 PSI.

2.12 VALVES

- A. OS&Y Gate:
 - 1. 2-1/2-inches and Larger: Iron body.
 - 2. 2-inches and Smaller: Bronze body.
- B. NRS Gate:
 - 1. Iron body. Non-rising stem with indicator post.
 - 2. Underground Butterfly Valves: Telescopic barrel type.
- C. Swing Check: Iron body, rubber and bronze faced checks.
- D. Wafer Check: Iron body, rubber seat, spring actuated.
- E. Butterfly Valves: Ductile iron body with factory-installed tamper switches. Use lug body next to pumps.
- F. Pressure Relief: Bronze body, stainless steel spring.
- G. Automatic Ball Drip Drain Valve: Bronze, spring-type.
- H. Three-Way Gauge Valve: Brass; rated to 300 psi.
- I. Automatic Air-Release Valve for Wet Systems:
 - 1. Rated to 175 psi.
 - 2. Automatic float-type with shutoff mounted in a water retention pan.
 - 3. Single set 24VAC@2A for electronic supervision.
 - 4. Ball valve switch with cover tamper.
- J. Ball Valves: Brass body, brass stem; forged brass ball disc.

2.13 PIPE, VALVE, AND FIRE PROTECTION EQUIPMENT IDENTIFICATION

- A. Engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker.
- B. Corrosion-resistant chain or permanent adhesive.

2.14 SIGNS

- A. Engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker.
- B. Corrosion-resistant chain or permanent adhesive.

2.15 DRAINS

- A. Reference Aboveground Black Steel Pipe and Fittings.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Install in conformance with UL Listing, FM Approval or ICC-ES requirements and restrictions.

3.02 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

- A. Piping Routing:
 - 1. Route piping, except as otherwise indicated, vertically and horizontally (sloped to drain). Avoid diagonal runs wherever possible. Orient horizontal routes parallel with walls and beam lines.
 - 2. Install piping as shown or described by diagrams, details and notations on Drawings or, if not indicated, install piping to provide the shortest route which does not obstruct usable space or block access for servicing the building and its equipment.
 - 3. Install piping in concealed spaces above finished ceilings. Prior to design and installation, obtain pre-approval by Architect for exposed piping.
 - 4. In open-to-structure areas which are open to public view, route exposed piping to minimize visual impact. Obtain Architect's and Engineer's approval of exposed piping installation.
 - 5. Coordinate installation with other trades. Route piping as required to avoid building structure, equipment, plumbing piping, HVAC piping, ductwork, lighting fixtures, electrical conduits and bus ducts and similar work. Final location of lighting will have priority over final sprinkler locations. Provide drains to trapped sections of system which result from such routing. Other trades take precedence for installation space.
 - 6. Support piping adjacent to walls, overhead construction, columns and other structural and permanent enclosure elements of the building. Limit clearance to 2-inches wherever furring is indicated for concealment of piping. Allow for insulation thickness. Locate insulated piping to provide minimum 1-inch clearance outside insulation.
 - 7. Wherever possible in finished and occupied spaces, conceal piping from view by locating within column or beam enclosures, hollow wall construction, or above suspended ceilings. Do not encase horizontal routes in solid partitions, except where approved.
 - 8. General Electrical Equipment Clearances: Do not route piping through electrical rooms, transformer vaults, elevator equipment rooms and other electrical or electronic equipment spaces and enclosures. Do not route piping above electric power or lighting panel, switchgear, low voltage panel, or similar electric device.
 - 9. Rooms Protected by Alternative Systems: Route water filled and dry system piping around rooms protected by pre-action systems, clean agent systems, gaseous suppression systems and other alternative fire suppression systems.
 - 10. Install pipe runs to minimize obstruction to other work.
 - 11. Pitch all dry and pre-action system piping 1/4-inch per 10-feet for mains and 1/2-inch per 10-feet for branch lines, including pipe passing through both warm and cold areas.
- B. Couplings:
 - 1. Install where indicated on Drawings and on each side of pieces of equipment to permit easy removal of equipment.
 - 2. Deburr cut edges.
- C. Pipe Penetrations: Wire pipe cutout coupon at point of pipe penetration.
- D. Pipe and Pipe Fittings:
 - 1. Expansion and Flexibility: Install work with due regard for expansion and contraction to prevent damage to the piping, equipment, building and its contents. Provide piping offsets, loops, approved type expansion joints, sway bracing, wire restraints, vertical restraints, flexible couplings or other means to control pipe movement and to minimize pipe forces.
 - 2. Coordinate support of pipe 4-inches and larger with Structural Engineer.
 - 3. Provide clearances around piping per NFPA 13.
 - 4. Install dry and pre-action welded pipe with welds facing vertically up, or where this is not possible, as close as possible to vertical between 46 degrees and 234 degrees. Intent is to minimize corrosion caused by moisture in the bottom of pipes.

3.03 WALL AND FLOOR PENETRATIONS AND SLEEVES

- A. Escutcheons: Install on exposed pipes passing through walls or floors.

1. Pipe Sleeves: Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.
2. Floor Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Extend sleeve 1-inch above finished floor. Caulk pipes passing through floor with nonshrinking fire and water resistant grout or approved equivalent caulking compound. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
3. Wall Sleeves: Provide sleeves on pipes passing through concrete or masonry construction. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with non-shrinking caulking compound. Caulk/seal piping passing through fire-rated building assemblies with UL Listed or FM Approved fire-rated firestopping compound. Provide fire-rated assemblies per local AHJ requirements.
4. Beam Sleeves: Coordinate with trades for locations of pipe sleeves in reinforced concrete and steel beams. Penetrations must be indicated on structural shop drawings. See Drawings and Specifications for specific sleeve location limitations. Pipe sleeve locations must be indicated on reinforced concrete and steel beam shop drawings. Field cutting of beams not allowed without written approval of structural engineer. No extra costs allowed for failure to coordinate beam penetrations prior to reinforced concrete and steel beam shop drawing submittal.
5. Penetrations in Fire-Rated Wall/Floor Assemblies:
 - a. Reference Division 07, Thermal and Moisture Protection.
 - b. Coordinate with Drawings location of fire rated walls, ceilings and floors. When these assemblies are penetrated, seal around piping and equipment with approved firestopping material.
 - c. Provide proper sizing when providing sleeves or core-drilled holes to accommodate the penetration. Firestop voids between sleeve or core-drilled hole and pipe passing through to meet the requirements of ASTM E814 and NFPA.
 - d. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814.

3.04 SWITCHES, VALVE SUPERVISORY

- A. Coordinate with Division 28, Electronic Safety and Security.

3.05 SWITCHES, WATER DETECTOR

- A. Wire pipe cutout coupon at point of connection of switch to pipe.
- B. Flow switches: Connect to system side of valves and drain connections.
- C. Coordinate with Division 28, Electronic Safety and Security.

3.06 HANGERS AND SUPPORTS

- A. Installation of pipe hangers, inserts and supports to conform to NFPA 13. Provide adjustable hangers, inserts, brackets, clamps, supplementary steel and other accessory materials required for proper support of pipe lines and equipment. Provide supplementary materials for proper support and attachment of hangers.

3.07 STRUTS AND STRUT CLAMPS

- A. Install per manufacturer's listed orientation.

3.08 SWAY BRACES AND RESTRAINTS

- A. Locate per orientation and spacing as required by sway brace calculations.
- B. Attach sway bracing directly to pipe or equipment being braced.
- C. Do not attach sway bracing to bottom of truss members.

3.09 ANCHORS AND ATTACHMENTS

- A. In post-tension construction, determine location of post-tension cables and install anchors to avoid contact or interference with post-tension cables. Coordinate with Structural.

- B. Do not use powder-driven attachments.
- C. Building Attachments and Inserts: Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves and flanges, for sizes NPS 2-1/2 and larger. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- D. Hanger and Support Attachments:
 - 1. Concrete:
 - a. Before Pouring: Prior to installation, coordinate locations of cast in place concrete inserts with other trades. Install in accordance with manufacturer's instructions.
 - b. After Pouring:
 - 1) Where supports in slabs are required after concrete has been poured, provide drilled-in threaded inserts (mechanical-expansion anchors), installed in accordance with manufacturer's recommendations.
 - 2) Install mechanical-expansion anchors after concrete is completely cured and in accordance with manufacturer's installation instructions.
 - 3) Where anchors are to be installed in post-tension construction, determine and avoid locations of post-tension cables prior to drilling.
 - 2. Metal Floor Deck: Support hangers per UL Listing or FM Approval for selected concrete insert before pouring of concrete topping, or from beam clamps fastened to structural steel.
 - 3. Steel Joists: Support hangers from beam clamps fastened to bar joists or to auxiliary steel between bar joists as required.
 - 4. C-Clamp Hangers: Do not attach to one side of double-angle bottom members.
 - 5. Locate and install hangers, supports and attachments connecting to I-joists, structural insulated panels (SIPs), cross laminated timber and similar engineered structural products according to the structural product manufacturer specifications.
- E. Make available to the Architect information required to verify the anchorage, sway bracing and restraint of fire protection systems.

3.10 PIPE STANDS

- A. Secure to floor.
- B. Install to maintain pipe level and plumb.
- C. Securely attach to supported pipe by u-bolt.

3.11 GAUGES

- A. Install gauges conveniently and accessibly located with reference to finished building for repairs, removal and service.
- B. Install with dial positioned for maximum visibility.

3.12 VALVES

- A. General:
 - 1. Provide post indicator on buried control valves.
 - 2. Inspect valves for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.
- B. Installation:
 - 1. Install valves where required for proper operation, testing and drainage. Locate valves so as to be accessible and so that separate support can be provided when necessary. Install conveniently and accessibly located with reference to finished building for repairs, removal and service.
 - 2. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.
 - 3. Wafer Check Valves: Install between two flanges in horizontal or vertical position, position for proper direction of flow.

- C. Pressure Relief Valves: Provide piping to permanent drain.

3.13 PIPE, VALVE, AND FIRE PROTECTION EQUIPMENT IDENTIFICATION

- A. Install engraved plastic laminate or corrosion resistant metal sign or plastic equipment marker, secured with corrosion-resistant chain or permanent adhesive on or near each Item of fire suppression equipment and each operational device, as specified in this specification if not otherwise specified for each Item or device.
- B. Provide signs for the following general categories of equipment and operational devices: Valves, drains, pumps, standpipes, tanks and similar equipment.
- C. Each new piece of equipment to bear a permanently attached identification plate, listing manufacturer's name, capacities, sizes and characteristics.
- D. Piping to bear the manufacturer's name, schedule of thickness, size and ASTM identification number
- E. Provide valve tag on every valve, control device, main drain, auxiliary drain, and drum drip in each system. Exclude check valves and valves within factory fabricated equipment units. List each tagged valve in valve schedule for each piping system.
- F. List each tagged item and its location in valve schedule; identify on fire suppression drawings.
- G. Install framed, glass or rigid transparent plastic covered, mounted valve schedule and valve location drawing in main riser or fire pump room.
- H. Provide identification sign on ceiling tile below valve location.
- I. Provide permanent identification sign at pressure regulating valves stating required setting of pressure regulator.
- J. Adjusting: Relocate fire suppression identification device which has become visually blocked.
- K. Cleaning: Clean face of identification devices and glass frames of valve charts.

3.14 SIGNS

- A. General Information Signs: Provide a general information sign used to determine system design basis and information relevant to the inspection, testing and maintenance requirements required by NFPA 25, Standard for the Inspection, Testing and Maintenance of Water-Based Fire Protection Systems. Such general information is to be provided with a permanently marked weatherproof metal or rigid plastic sign, secured with corrosion-resistant wire, chain, or other acceptable means. Such signs are to be placed at each system control rise loop and auxiliary system control valve. The sign is to include the following information:
 - 1. Name and Location of the Facility Protected
 - 2. Presence of High-Piled and/or Rack Storage
 - 3. Maximum Height of Storage Planned
 - 4. Flow Test Data
 - 5. Location of Auxiliary Drains and Low Point Drains
 - 6. Original Results of Main Drain Flow Test
 - 7. Name of Installing Contractor or Designer
 - 8. Indication of presence and location of other auxiliary systems.
- B. Dry Signs: At system riser supplying dry systems, provide the following information: volume in gallons contained in each system.

3.15 DRAINS

- A. Locate drain connections within 7-feet of floor. Provide piping capable of being fully drained.
- B. Provide a drain vent at top of vertical drains. Coordinate with Division 22, Plumbing.
- C. Coordinate location of auxiliary drains with Architect. Architect to approve location before drain is installed.
- D. Protect drains from tampering and accidental operation.

E. Protect drain discharge at the exterior with a turned-down 45 degree elbow.

END OF SECTION

SECTION 21 13 00 - FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Sprinklers
 - 2. Flexible Sprinkler Hose Fitting Assembly - For fire sprinklers in suspended ceilings which are supplied by a wet pipe system.
 - 3. Riser Manifold
 - 4. Inspector's Test Connection
- B. This is a contractor designed system. Contact AHJ prior to bid to verify fire system requirements. Provide design compliant with codes as interpreted by AHJ.
- C. Scope: Revision and extension of existing system to new and remodeled areas.
- D. Coordinate location and type of tamper, flow and pressure switches and fire alarm system.
- E. Provide electrical connections and wiring as required for a complete and operable system. Includes but is not limited to bells, air compressors, sump pumps, fire pumps, jockey pumps and pump controllers.

1.02 RELATED SECTIONS

- A. Contents of Division 21, Fire Suppression and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 22, Plumbing
 - 2. Division 23, Heating, Ventilating and Air-Conditioning
 - 3. Division 26, Electrical
 - 4. Division 28, Electronic Safety and Security
 - 5. Section 21 00 00, Fire Suppression Basic Requirements
 - 6. Section 21 05 00, Common Work Results for Fire Suppression

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Hydraulic calculations.
 - 2. Sway brace calculations.
 - 3. Details of sway bracing.
 - 4. Details of interval and end of branch line restraints.
 - 5. Details of flexible sprinkler hose fitting assembly, including number and radius of bends, corresponding to equivalent feet used in hydraulic calculations. Provide details of sign to be installed at each flexible sprinkler hose fitting assembly.
 - 6. Details of oversized ceiling penetrations and oversized sprinkler escutcheons.
 - 7. Trapeze hanger details and calculations, including size, length and material. Additionally, provide size, weight and number of pipes to be carried on the trapeze.
 - 8. On submittal and As-Built drawings, provide text of sprinkler list to be installed in the spare sprinkler cabinet.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

- A. Provide coverage for building areas as indicated. Field verify field conditions prior to submittal of bid. Adjust bid to provide protection features in accordance with applicable codes and interpretations by AHJ. Provide design and installation based on more stringent requirements if this specification and AHJ requirements differ from Code.
- B. Design Parameters:
 - 1. Building Areas: Locker Rooms and Team Rooms.
 - a. Occupancy Classification: Light.
 - 2. Building Areas: Mechanical Rooms, Small Storage Rooms.
 - a. Occupancy Classification: Ordinary Group 1.
 - 3. Design parameters above are NFPA 13 minimums. Provide increased design densities, design areas and hose allowances to meet requirements of AHJ.
- C. Sprinkler system design to include a 10 percent pressure and flow cushion between system demand point and available water supplies.
- D. Extend hydraulic calculations from hydraulically most remote design area back to location of pressure hydrant of flow test or effective point of water supply where characteristics of water supply are known.

1.08 EXTRA STOCK

- A. Provide extra sprinklers per code.
- B. Provide suitable wrenches for each sprinkler type and metal storage cabinet in riser room.

1.09 CONTROL VALVES

- A. Sprinkler system control valves to be OS&Y or butterfly valves located inside building in a room with outside door.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Sprinklers:
 - 1. Finished Areas:
 - a. Victaulic
 - b. Viking
 - c. Tyco
 - d. Reliable
 - e. Globe
 - f. Senju
 - g. Or approved equivalent.
 - 2. Nonfinished Areas:
 - a. Victaulic
 - b. Viking
 - c. Tyco
 - d. Reliable
 - e. Globe
 - f. Or approved equivalent.
- B. Flexible Sprinkler Hose Fitting Assembly:
 - 1. Victaulic; VicFlex.
 - 2. Flexhead Industries
 - 3. SprinkFLEX

4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 5. Reliable Automatic Sprinkler Company
 6. Tyco Fire and Building Products
 7. Viking Corporation
 8. Or approved equivalent.
- C. Riser Manifold:
1. Viking EasyPac
 2. Reliable; Model CR.
 3. AGF; Model 8011.
 4. Tyco; Model RM-1
 5. Or approved equivalent.
- D. Inspector's Test Connection:
1. Combination Test and Drain:
 - a. Victaulic; Series 720 TestMaster II Alarm Test Module with pressure relief valve.
 - b. AGF; Model 1011, 2511, 3011, with pressure relief valve.
 - c. Or approved equivalent.

2.02 SPRINKLERS

- A. Finished Areas:
1. Type: Glass-Bulb
 2. Style: Recessed
 3. Response: Quick-Response
 4. Finish: Architect to select from available standard finishes.
 5. Escutcheon: Architect to select from available standard finishes.
- B. Nonfinished Areas:
1. Type: Glass-Bulb
 2. Response: Quick-Response
 3. Finish: Brass
- C. Pendent sprinklers supplied by dry or preaction piping: Dry pendent type.

2.03 FLEXIBLE SPRINKLER HOSE FITTING ASSEMBLY

- A. Fully welded non-mechanical fittings, stainless steel, braided, leak-tested with minimum 1-inch true-bore internal corrugated hose diameter. 175 psi.
- B. Ceiling Bracket: Galvanized steel, direct attachment type, with integrated snap-on clip ends and removable flexible hose attachment with set screw. FM1637, UL 2443.
- C. Affix permanent sign, label or decal at each flexible sprinkler hose fitting assembly anchoring component limiting the relocation of the sprinkler.

2.04 RISER MANIFOLD

- A. Water-flow alarm, gauge, integral pressure relief valve connected to drain, pressure gauge with 3-way gauge control valve and drain valve, integral pressure relief valve connected to drain, sight glass, smooth bore orifice union of same size as smallest orifice sprinkler installed. Provide cover tamper switch when required by AHJ.

2.05 INSPECTOR'S TEST CONNECTION

- A. Combination Test and Drain: Bronze body, brass stem, impregnated Teflon seat, chrome coated brass ball, steel handle with positive stops, tamper resistant test orifice, integral tamper resistant sight glasses, tapped and plugged port for system access, steel identification plate. Provide with pressure relief valve and drainage piping with bronze body and stainless steel spring.

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- A. Install per manufacturer's requirements and recommendations.

3.02 SPRINKLERS

- A. Center sprinklers in center or quarter points of suspended ceiling tile.
- B. Align sprinklers with architectural column lines, lighting, diffusers and other ceiling features. In unfinished ceilings, route piping to minimize visual impact. Sprinklers and piping not so aligned are to be removed and replaced at no additional cost to Owner.
- C. Install dry sprinklers in a manner which does not trap water.

3.03 FLEXIBLE SPRINKLER HOSE FITTING ASSEMBLY

- A. Install flexible sprinkler hose fitting assemblies where pendent sprinkler heads are located in acoustic ceiling tiles.
- B. Install with no more bends than are included in equivalent footage used in hydraulic calculations.
- C. Maintain manufacturer's recommended bending radius as included in equivalent footage used in hydraulic calculations.
- D. Affix permanent sign, label or decal at each flexible sprinkler hose fitting assembly anchoring component limiting the relocation of the sprinkler.

3.04 RISER MANIFOLD

- A. Install so valves and gauges are conveniently and accessibly located with reference to finished building for repairs, removal and service.
- B. Provide connection to drain.
- C. Pipe pressure relief valve to drain.
- D. Install with supervised control valve(s) and check valve.

3.05 INSPECTOR'S TEST CONNECTION

- A. Locate where full flow discharge or pressure relief valve discharge will not do damage, including damage to landscaping and will not cause dangerous conditions to walking surfaces or discoloration to building surfaces.
- B. Locate within 5-feet of finished floor.

END OF SECTION

SECTION 22 00 00 - PLUMBING BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 DESIGN-BUILD SUMMARY OF WORK

- A. Work included in 22 00 00 applies to Division 22, Plumbing work to provide materials, labor, tools, permits and incidentals to make plumbing systems ready for Owner's use for proposed project.

1.02 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install a complete plumbing system for this project.
- B. Alternates to this Document may be offered as a separate proposal.
- C. Bidder to submit the following information with the Proposal:
 - 1. Preliminary drawings indicating major equipment locations and preliminary layout.
 - 2. Description of systems, manufacturer and method of control.
 - 3. List of materials proposed for systems which are applicable to this project.
 - 4. Any other information which the bidder considers pertinent in evaluating the proposal.

1.03 DESIGN-BUILD DESIGN APPROACH

- A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.04 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere:
 - 1. Contents of Section apply to Division 22 Specifications.
 - 2. Requirements of Section are a minimum for Division 22 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Design Criteria: Per the Basis of Design Narrative.
- C. Calculations:
 - 1. Submit the following Plumbing Calculations:
 - a. Water Sizing Calculations
 - b. Sanitary Drainage Calculations
 - c. Storm Drainage Calculations
 - d. Structural Calculations for Seismic Bracing of Plumbing Equipment and Piping
 - e. Structural calculations to be signed by a registered Engineer in the State of California.
 - f. Rainwater Harvesting Calculations
 - g. Hot Water Heater Calculations

1.05 SECTION INCLUDES

- A. Work included in 22 00 00, Plumbing Basic Requirements applies to Division 22, Plumbing work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of plumbing systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.

3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work furnished.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.06 RELATED SECTIONS

- A. Contents of Section applies to Division 22, Plumbing Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.07 REFERENCES AND STANDARDS

- A. References and Standards per Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, individual Division 22, Plumbing Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of California:
 - a. CBC - California Building Code
 - b. CEC - California Electrical Code
 - c. CEC T24 - California Energy Code Title 24
 - d. CFC - California Fire Code
 - e. CMC - California Mechanical Code
 - f. CPC - California Plumbing Code
 - g. CSFM - California State Fire Marshal
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ADA - Americans with Disabilities Act
 3. AHRI - Air-Conditioning Heating & Refrigeration Institute
 4. ANSI - American National Standards Institute
 5. ASCE - American Society of Civil Engineers
 6. ASHRAE - American Society of Heating, Refrigerating and Air-Conditioning Engineers
 7. ASHRAE Guideline 0, the Commissioning Process
 8. ASME - American Society of Mechanical Engineers
 9. ASPE - American Society of Plumbing Engineers
 10. ASSE - American Society of Sanitary Engineering
 11. ASTM - ASTM International
 12. AWWA - American Water Works Association

13. CFR - Code of Federal Regulations
14. CGA - Compressed Gas Association
15. CISPI - Cast Iron Soil Pipe Institute
16. ETL - Electrical Testing Laboratories
17. EPA - Environmental Protection Agency
18. FM - FM Global
19. IAPMO - International Association of Plumbing and Mechanical Officials
20. GAMA - Gas Appliance Manufacturers Association
21. HI - Hydraulic Institute Standards
22. ISO - International Organization for Standardization
23. MSS - Manufacturers Standardization Society
24. NEC - National Electric Code
25. NEMA - National Electrical Manufacturers Association
26. NFGC - National Fuel Gas Code
27. NFPA - National Fire Protection Association
28. NRCA - National Roofing Contractors Association
29. NSF - National Sanitation Foundation
30. OSHA - Occupational Safety and Health Administration
31. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
32. TEMA - Tubular Exchanger Manufacturers Association
33. TIMA - Thermal Insulation Manufacturers Association
34. UL - Underwriters Laboratories Inc.

D. See Division 22, Plumbing individual Sections for additional references.

1.08 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 22, Plumbing Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, two separate submittals may be provided, consisting of underground work and building work. Deviations will be returned without review.
 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 22, Plumbing Sections.
 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

- a. Label submittal to match numbering/references as shown in Contract Documents and schedules. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference Division 22, Plumbing Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection. Indicate frame type where required. Submit manufacturer's product data.
 - e. See Division 22, Plumbing Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of complete submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
 7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet ASCE 7-10 requirements for non-structural components. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
 8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required per Division 22, Plumbing Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
 9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
 10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.
 11. Shop Drawings: Provide coordinated Shop Drawings which include physical characteristics of all systems, equipment and piping layout plans, and control wiring diagrams. Reference

- individual Division 22, Plumbing Sections for additional requirements for Shop Drawings outside of these requirements.
- a. Provide Shop Drawings indicating sanitary and storm cleanout locations and type to Architect for approval prior to installation.
 - b. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
- a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates no exception taken or "make corrections as noted".
 - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
- a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 4) Include copy of startup and test reports specific to each piece of equipment.
 - 5) Include copy of final water systems balancing log along with pump operating data.
 - 6) Include commissioning reports.
 - 7) Include copy of pressure, flow, leakage and purity test data and air and water systems test data, as applicable. Include copy of third-party and state and local jurisdiction inspection reports.
 - 8) Include copy of valve charts/schedules.
 - 9) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
 - 10) Include product certificates of warranties and guarantees.
 - 11) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
 - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable

training aids and systems demonstrations. Field instruction per Section 22 00 00, Plumbing Basic Requirements article titled "Demonstration".

- c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on Drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project on CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
 - d. Provide Invert elevations and dimensioned locations for water services, building waste, and storm drainage piping below grade extending to 5-feet outside building line.
 - e. See Division 22, Plumbing individual Sections for additional items to include in record drawings.

1.09 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturers equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. All potable water system components, devices, material, or equipment containing a weighted average of greater than 0.25 percent lead are prohibited, and shall be certified in accordance with current editions of the Safe Drinking Water Act (SDWA), NSF 61 & NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61.

- I. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- J. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty in Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, plumbing equipment/fixtures, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in the event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.12 WORK INCLUDED

- A. Furnish and install sleeves, inserts and anchorage required for the installation, which are embedded in work of other trades. Sleeve, wrap and seal piping in concrete.
- B. Electrical: For plumbing trim/devices/equipment, provide, from the line voltage connection by Division 26, the low voltage electrical connections and wiring as required for complete and operable system. Includes, but is not limited to: Low voltage electrical raceway, wiring and accessories, such as step-down transformers as necessary for function of sensors and automatic valve and faucet controls. Supply step-down transformers and size wiring as recommended by manufacturer of plumbing trim/faucets requiring electrical low voltage connection.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL approved or have adequate approval or be acceptable by State, County, and City authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.

- C. Hazardous Materials:
 - 1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment requiring access (i.e., drain pans, drains, control operators, valves, motors, cleanouts and water heaters) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing, and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with the provisions of related earthwork Sections/divisions. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
 - 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
 - 2. Include provisions for servicing and removal of equipment without dismantling piping.

- G. Plenums:
 - 1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.02 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment, and individual Division 22 Plumbing Sections.
- B. Piping:
 - 1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- C. Provide means to prohibit excessive motion of plumbing equipment during earthquake.

3.03 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
 - 1. Underground piping installation prior to backfilling.
 - 2. Prior to covering walls.
 - 3. Prior to ceiling cover/installation.
 - 4. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Bear responsibility and cost to make piping accessible, to expose concealed lines, or to demonstrate acceptability of the system. If Contractor fails to notify Architect at times prescribed above, costs incurred by removal of such work are the responsibility of the Contractor.
- D. Final Punch:
 - 1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Plumbing Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the plumbing systems are ready for final punch.
 - 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 - 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping, and wiring to point of connection.
 - 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 - 4. Organize work to minimize duration of power interruption.

3.05 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:

1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.
3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing piping and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.

3.08 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.09 CLEANING

- A. Confirm cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Do not place equipment in sustained operation prior to initial balancing of plumbing systems.
 - 2. Provide pump impellers to obtain Basis of Design design capacities.
- D. Provide miscellaneous supports/metals required for installation of equipment and piping.

3.11 PAINTING

- A. Confirm requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Ferrous Metal: After completion of plumbing work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping: Clean, primer coat and paint exposed piping on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals

- d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document and Commissioning Reports
- B. Reference State of California requirements for specific testing procedures and documentation requirements. Comply with State and local governmental standards and requirements for testing, and completion and submittal of appropriate forms as required by Title 24 and local governmental agencies related to this work.

3.13 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 22 00 00, Plumbing Basic Requirements and individual Division 22, Plumbing Sections.
- B. Tests:
- 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in operation and maintenance manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that plumbing items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.15 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize plumbing equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

END OF SECTION

SECTION 22 05 19 - PLUMBING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Pressure Gauges
 - 2. Thermometers
 - 3. Test Plugs
 - 4. Water Hammer Arrestors (Shock Absorbers)
 - 5. Trap Primers

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Pressure Gauges:
 - 1. Dwyer Instruments, Inc.
 - 2. Moeller Instrument Co., Inc.
 - 3. Omega Engineering, Inc.
 - 4. Terice
 - 5. Or approved equivalent.
- B. Thermometers:
 - 1. Ashcroft
 - 2. Terice
 - 3. Weiss
 - 4. Marshalltown
 - 5. Weksler
 - 6. Or approved equivalent.
- C. Test Plugs:
 - 1. Pete's Plug
 - 2. Or approved equivalent.
- D. Water Hammer Arrestors (Shock Absorbers):
 - 1. Bellows Type:
 - a. Amtrol
 - b. J.R. Smith
 - c. Wade
 - d. Zurn

- e. Or approved equivalent.
- 2. Piston Type:
 - a. PPP
 - b. Sioux Chief
 - c. Or approved equivalent.
- E. Trap Primers:
 - 1. Wade
 - 2. Zurn
 - 3. J.R. Smith
 - 4. PPP
 - 5. Or approved equivalent.

2.02 PRESSURE GAUGES

- A. Pressure Gauges: ASME B40.100, phosphor-bronze bourdon type, dry type.
 - 1. Case: Cast aluminum, stem-mounted, flange less.
 - 2. Size: 4-1/2-inch diameter.
 - 3. Window: Clear glass.
 - 4. Connector: Brass.
 - 5. Scale: White aluminum with black graduation and markings.
 - 6. Pointer: Black, adjustable.
 - 7. Mid-Scale Accuracy: One percent.
 - 8. Scale: PSI and KPa.
 - 9. Basis of Design: Trerice Model 600CB.

2.03 THERMOMETERS

- A. Thermometers - Adjustable Angle: Red or blue appearing organic liquid in glass, ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
 - 1. Size: 9-inch scale.
 - 2. Window: Acrylic.
 - 3. Scale: Aluminum, white background, black graduations and markings.
 - 4. Stem: 3/4-inch NPT brass (aluminum for installation in air ducts).
 - 5. Accuracy: 2 percent, per ASTM E 77.
 - 6. Calibration: 0-160 with 2 Degrees F graduations.
 - 7. Basis of Design: Trerice BX9.

2.04 TEST PLUGS

- A. Test Plug Description: 1/4-inch or 1/2-inch fitting and cap for receiving 1/8-inch outside diameter pressure or temperature probe.
- B. Body: Brass or Stainless steel body test plug. Provide "XL" fitting to extend beyond insulation.
- C. Pressure Rating: 500 PSIG maximum.
- D. Core Inserts: One or two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gauge.
- E. Core Material:
 - 1. For waxes, fats, oils, greases, petroleum products and most refrigerants: 32 to 200 degrees F, chloroprene synthetic rubber (Neoprene).
 - 2. For hot and cold water, low steam, detergents, phosphate esters, keytone, alcohols, and glycols (not suitable for petroleum products): 32 to 275 degrees F, ethylene-propylene-diene-monomer synthetic rubber (Nordel).
- F. Test Plug Cap: Gasketed and threaded cap, with retention chain or strap.

- G. Test Kit: Pressure gauge and adapter with probe, two bimetal dial thermometers, and carrying case.
 - 1. Pressure Gauge and Thermometer Ranges: Approximately two times the system's operating conditions.

2.05 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

- A. Bellows-type, stainless steel casing and bellows, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.
- B. Piston-type, copper, brass or stainless steel with O-ring piston, pressure rated, tested and certified in accordance with PDI WH-201 or ASSE 1010.

2.06 TRAP PRIMERS

- A. Trap automatic primer valve with integral anti siphon protection. Code approval required.
- B. Flush valve tail-piece trap primer. PPP FVP-1VB.
- C. Electronic trap seal automatic primer valve with integral anti siphon protection and timer. Coordinate quantity, locations and voltage characteristics for control points.
- D. Trap seal primer valve (low lead) with integral automatic anti-siphon protection. The priming valve to discharge on both pressure drop and pressure spike. PPP CPO 500.

END OF SECTION

SECTION 22 05 23 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Valves, General
 - 2. Balancing Valves
 - 3. Ball Valves
 - 4. Swing Check Valves
 - 5. Backflow Prevention Assemblies
 - 6. Pressure Regulating Valve-Domestic Water
 - 7. Thermostatic Master Mixing Valves (ASSE 1017 Rated)
 - 8. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated)

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G and/or NSF/ANSI 372 for potable water services. Valves must be 3rd-party certified.
 - 2. ISO 9001 Certified.
 - 3. IAPMO Certified for Low Lead.
- C. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- D. Model numbers indicated as Basis-of-Design indicate valve characteristics. All valves are to meet code Low Lead/Lead Free Standards.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- B. Valves, General:
 - 1. Apollo
 - 2. Armstrong
 - 3. ASCO
 - 4. Cla-Val
 - 5. Conbraco
 - 6. Crane
 - 7. Clow

8. Griswold
 9. Hammond
 10. Hays
 11. Jenkins
 12. Josam
 13. Kennedy
 14. Milwaukee
 15. Mueller
 16. Nibco
 17. Red-White Valve
 18. Smith
 19. Stockham
 20. Tour Anderson
 21. Wade
 22. Watts
 23. Wilkins
 24. Zurn
 25. Or approved equivalent.
- C. Balancing Valves:
1. Caleffi
 2. Griswold
 3. Hays
 4. Armstrong CBV
 5. Tour Anderson
 6. Or approved equivalent.
- D. Ball Valves:
1. See Valves General above.
 2. NSF Valves:
 - a. Clow
 - b. Kennedy
 - c. Nibco
 - d. Or approved equivalent.
- E. Swing Check Valves:
1. See Valves General above.
- F. Backflow Prevention Assemblies:
1. Backflow Preventers:
 - a. Apollo
 - b. Cla-Val
 - c. Conbraco
 - d. Watts
 - e. Or approved equivalent.
 2. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-inches and Smaller:
 - a. Febco 860-with 650A.
 - b. Conbraco 40-210-AGD.
 - c. Wilkins 375-XL-SAG.
 - d. Watts 919-QT-S valve with 919AGC or 919AGF.
 - e. Or approved equivalent.
 3. Backflow Prevention Assemblies - Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications - 2-1/2-inches and Larger:
 - a. Febco 860 with 758A.
 - b. Conbraco Apollo 40-700 with 758A.

- c. Watts 909-S-NFA-NRS with AGC.
- d. Wilkins 375-FSC.
- e. Or approved equivalent.
- 4. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-inches and smaller:
 - a. Febco 850-650A
 - b. Conbraco Apollo 40-110-T2
 - c. Watts 007-QT-FDA-S
 - d. Wilkins 350-S-XL
 - e. Or approved equivalent.
- 5. Backflow Prevention Assemblies - Double Check Valve Assembly (DCVA) for Low Hazard Applications - 2-1/2-inches and larger:
 - a. Conbraco Apollo 45-11-1
 - b. Watts 709-DCDA with 77F-01-FDA-12
 - c. Or approved equivalent.
- 6. Spill Resistant Pressure Vacuum Breaker:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equivalent.
- 7. Atmospheric Vacuum Breakers:
 - a. Febco
 - b. Conbraco
 - c. Watts
 - d. Wilkins
 - e. Or approved equivalent.
- G. Pressure Regulating Valve-Domestic Water:
 - 1. Cash Acme
 - 2. Cla-Val
 - 3. Watts
 - 4. Wilkins
 - 5. Or approved equivalent.
- H. Thermostatic Master Mixing Valves (ASSE 1017 Rated):
 - 1. Holby Tempering Valve
 - 2. Lawler Series 66
 - 3. Leonard Type TM
 - 4. Powers LFMM430 (Lead Free)
 - 5. Symmons Temp Control Series 5
 - 6. Or approved equivalent.
- I. Thermostatic Point-of-Use Mixing Valves (ASSE 1070 Rated):
 - 1. Lawler
 - 2. Leonard
 - 3. Powers Hydroguard
 - 4. Or approved equivalent.

2.02 VALVES - GENERAL

- A. General:
 - 1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 - 2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6-inches and smaller. Provide gear operators for quarter-turn valves 8-inches and larger and plug valves installed over 5-feet above finished floor.

3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- B. Valves in Insulated Piping: With 2-inch stem extension and following features:
 1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation on valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.
- C. Valve-End Connections:
 1. Flanged: With flanges according to ASME B16.1 for iron valves.
 2. Solder Joint: With sockets according to ASME B16.18.
 3. Threaded: With thread according to ASME B1.20.1.
- D. Valve Bypass and Drain Connections: MSS SP-45.
- E. Building Service:
 1. Shutoff and Isolation Valves:
 - a. Pipe Sizes 3-inches and Smaller: Ball Valve.
 2. Drain Service: Ball Valves.
 3. Strainer Blow-Off: Ball Valve.
 4. Check Valves: Swing.

2.03 BALANCING VALVES

- A. Maximum 125 PSIG System Working Water Pressure.
- B. Manual Set Balancing Valves:
 1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shut-off.
 2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. Valves to be furnished with flow smoothing fins downstream of the valve seat and integral to the forged valve body to make the flow more laminar. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.
 3. 2-1/2-inch and Larger: Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shut off. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators location on the valve handwheel. Valves to have a minimum of five full 360 degree handwheel turns. 90 degree circuit-setter style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch - five turns, sizes 4-inch to 6-inch - 6 turns, sizes 8-inch to 10-inch - 12 turns and size 12-inch - 14 turns. Flange adapters to be provided to prevent rotation.

2.04 BALL VALVES

- A. All ball valves on brazed piping are to be three-piece.
- B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 77CLF 100 Series two-piece.
- C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 82-100/82A 140 Series three-piece.
- D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

2.05 SWING CHECK VALVES

- A. 2-inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80.
- B. 2-1/2-inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MMS SP-71.
- C. Rubber Flapper Check Valve: Horizontal or vertical upward flow installation. Working pressure to 175 PSI. Ductile iron or cast iron body. Steel reinforced Buna-N rubber flapper epoxy coating on wetted parts. MSS SP-80.
- D. Check Valve: Horizontal installation. Working pressure to 300 PSI, Type 304/302 Stainless Steel conforming to ASTM 167. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

2.06 BACKFLOW PREVENTION ASSEMBLIES

- A. General: Assemblies model numbers listed below are for general comparison. Project specific model numbers to be verified contractor as approved by jurisdiction where project is located.
- B. Reduced Pressure Zone Backflow Preventer (RPBP) for High Hazard Applications:
 - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1013 and AWWA C511. Bronze construction, threaded ends, stainless steel internal parts, FDA strainer, and air gap fitting. Route pipe from air gap fitting to approved waste receptor.
 - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and pressure-differential relief valve located between two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C511. Epoxy coated cast iron body construction, flanged ends, stainless steel internal parts, bronze seats, and FDA strainer.
- C. Double Check Valve Assembly (DCVA) for Low Hazard Applications:
 - 1. 2-inches and Smaller: Assembly consists of shutoff ball valves in inlet and outlet, and FDS strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Bronze construction, threaded ends, and stainless steel internal parts.
 - 2. 2-1/2-inches and Larger: Assembly consists of shutoff OS&Y gate valves in inlet and outlet, and strainer on inlet. Assemblies include test cocks and two positive seating check valves and comply with requirements of ASSE Standard 1015 and AWWA C510. Epoxy coat cast iron body construction, strainer flanged ends, and stainless steel internal parts.
- D. Spill Resistant Pressure Vacuum Breaker: Watts Model 800MCQT with 777S "Y" strainer.

- E. Atmospheric Vacuum Breaker: Assembly consists of a bronze vacuum breaker body with silicone disc, and full size orifice. Device to be IAPMO listed, meet ASSE standard 1001, and ANSI standard A113.1.1 rough chrome plate finish.

2.07 PRESSURE REGULATING VALVE-DOMESTIC WATER

- A. Water: Bronze body, diaphragm or piston type, spring actuated, with separate or integral stainless steel strainer, pressure range to suit conditions, approved for potable water use, low lead. Provide shutoff valves, pressure relief valves, unions, drain valve and bypass.
- B. Water: Automatic control pressure regulating valve, stainless steel seat, stem and spring, diaphragm actuated with brass body, hydraulic control pilots with effluent operating temperature range 32 degrees F to 180 degrees F, FDA and AWWA approved.
- C. Water: Bronze body construction, stainless steel strainer screen, thermal expansion bypass with renewable stainless steel seat and high temperature resisting diaphragm.

2.08 THERMOSTATIC MASTER MIXING VALVES (ASSE 1017 RATED)

- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1017.
- B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.
- C. Flow from the tempered water circulating pump to be split to mixing valve and building hot water heating system.

2.09 THERMOSTATIC POINT-OF-USE MIXING VALVES (ASSE 1070 RATED)

- A. Thermostatic type with bronze body construction, corrosion resistant materials, union end stops, check inlets with strainers, 0-200 degree F dial thermometer and discharge shut-off valve. Mixing valves to meet ASSE 1070.
- B. Maximum required delta temperature differential between hot water supply temperature and delivery temperature is 15 degrees F. Set valve outlet temperature per drawing requirements.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Pipe Hangers and Supports for Plumbing Piping and Equipment
 - 2. Wall and Floor Sleeves
 - 3. Building Attachments
 - 4. Flashing
 - 5. Miscellaneous Metal and Materials

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.
 - 2. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.
 - 3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 - 4. Install piping per SMACNA's requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

- A. General - Provide pipe and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for piping are not shown on the Drawings, the contractor is responsible for their design.
 - 2. Connections to structural framing are not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 - 1. Support frames such as pipe racks or stanchions for piping and equipment which provide support from below.
 - 2. Equipment and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting the combined weight of supported systems, system contents and test water.
- E. Provide seismic restraint hangers and supports for piping and equipment. See Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment.

- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 22 05 48, Vibration and Seismic Controls for Plumbing Piping and Equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Pipe Hangers and Supports for Plumbing Piping and Equipment:
1. Pipe Hangers/Supports:
 - a. B-Line Systems, Inc.
 - b. Anvil International
 - c. HOLDRITE
 - d. Erico Co., Inc.
 - e. Snappitz Thermal Pipe Shield Manufacturing
 - f. Rilco Manufacturing Co. Inc.
 - g. Nelson-Olson Inc.
 - h. Or approved equivalent.
 2. Channel Support Systems:
 - a. B-Line Systems, Inc.
 - b. Anvil International, Anvit-Strut
 - c. Erico Hanger Co., Inc.; O-Strut Div.
 - d. Unistrut Corp.
 - e. HOLDRITE EZ-Strut Systems
 - f. Or approved equivalent.
 3. Thermal-Hanger Shield Inserts:
 - a. Erico Hanger Co., Inc.
 - b. Pipe Shields, Inc.
 - c. Rilco Manufacturing Co., Inc.
 - d. HOLDRITE Insulation Couplings
 - e. Or approved equivalent.
 4. Freestanding Roof Supports:
 - a. Erico Hanger Co., Inc.
 - b. Nelson-Olsen Inc.
 - c. B-Line
 - d. M. Fab
 - e. Or approved equivalent.
 5. Pipe Alignment and Secondary Supports:
 - a. HOLDRITE
 - b. Starquick
 - c. Or approved equivalent.
- B. Wall and Floor Sleeves:
1. Below Grade and High Water Table Areas:
 - a. Modular Link Sealing System at Pipe Sleeves:
 - 1) Thunderline Corporation
 - 2) Or approved equivalent.
 2. Pre-Engineered Firestop Pipe Penetration Systems:
 - a. HOLDRITE HydroFlame
 - b. Proset
 - c. Or approved equivalent.
- C. Building Attachments:
1. Anchor-It
 2. Gunnebo Fastening Corp.
 3. ITW Ramset/Red Head

4. Masterset Fastening Systems, Inc.
 5. Or approved equivalent.
- D. Flashing:
1. Fastenal
 2. Or approved equivalent.
- E. Miscellaneous Metal and Materials:
1. See Miscellaneous Metal and Materials article below.
 2. Powder-Actuated Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.
 - d. Masterset Fastening Systems, Inc.
 - e. Or approved equivalent.

2.02 PIPE HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

- A. Horizontal Piping Hangers and Supports - Horizontal and Vertical Piping, and Hanger Rod Attachments:
1. Factory fabricated horizontal piping hangers and supports to suit piping systems in accordance manufacturer's published product information.
 2. Use only one type by one manufacturer for each piping service.
 3. Select size of hangers and supports to exactly fit pipe size for bare piping and to exactly fit around piping insulation with saddle or shield for insulated piping.
 4. Provide copper-plated hangers and supports for uninsulated copper piping systems.
 5. Provide padded pipe hangers, clamps and supports for thermoplastic piping system.
 6. Install no hub cast iron pipe and fittings per CISPI 301-09 Installation Procedures for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain Waste and Vent Piping Applications. Brace hubless cast iron pipe and fittings 5-inch and larger with HOLDRITE No Hub Pipe Restraints or approved equivalent.
- B. Pipe Hangers, Guides and Channel Systems:
1. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.
 2. Hanger Rod Couplings: Malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
 3. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, MSS SP Type 6 or Type 10, or approved equivalent. Pipe sizes 2-1/2-inches and larger, clevis type hangers with adjustable nuts on rod. MSS SP Type 1. Pipe rings to have same finish as hanger rods.
 4. Pipe Slides: Type 35 reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
 5. Pipe Guides:
 - a. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Any contact with chilled water pipe is not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - b. Furnish and install guides approximately 4 pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
 6. Channel Type Pipe Hanging System: Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33; one side of channel to

have a continuous slot with in-turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.

- C. Pipe Saddles and Shields:
 - 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 - 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- D. Thermal-Hanger Shield Inserts: 100-PSI (690-kPa) minimum compressive strength insulation, encased in sheet metal shield.
 - 1. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier.
 - 2. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate.
 - 3. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 4. For Clevis or Band Hanger: Insert and shield to cover lower 180 degrees of pipe.
 - 5. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 - 6. Thermal Hanger Shield Inserts should be provided at the hanger points and guide locations on pipes requiring insulation. The Inserts should consist of Polyisocyanurate (urethane or phenolic insulation) encircling the entire circumference of the pipe with a 360 degree PVC (1.524 mm thick) with a living hinge and J lock and installed during the installation of the piping system.
- E. Roller Hangers:
 - 1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- F. Concrete Inserts:
 - 1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- G. Continuous Concrete Insert:
 - 1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- H. Beam Clamps:
 - 1. MSS Type 19 and 23, wide throat, with retaining clip.
 - 2. Universal Side Beam Clamp: MSS Type 20.
- I. Below Ground:
 - 1. Pipe Hangers: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 316. MSS Type 1. If PVC piping to be used, provide Type 1 hanger, coated for PVC piping.
 - 2. Rod: 5/8-inch stainless steel Type 316.
 - 3. Eyebolt: Stainless steel Type 316.
 - 4. Nuts and Washers: Stainless steel Type 316.
- J. Hangers for Pipe Size 2-inches and Smaller:
 - 1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- K. Hangers for Pipe Size 2-1/2-inches and Larger:
 - 1. Adjustable clevis type, UL listed, Type 1.
- L. Riser Clamps:
 - 1. Steel, UL listed. MSS Type 8.
- M. Plumbers Tape:
 - 1. Not permitted as pipe hangers or pipe straps.
- N. Pipe Alignment and Secondary Support Systems:
 - 1. Secondary Pipe supports for general applications (Non-Acoustical).

- a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
- b. Supports may be used when sound and/or vibration transfer is not a concern.
- 2. Secondary pipe supports for sound and vibration attenuation (Acoustical).
 - a. Supports will be manufactured in compliance with IAPMO Product Standard PS 42-96. All products provided will be listed by IAPMO for secondary pipe support.
 - b. Acoustical pipe supports will be manufactured and installed in compliance with International Organization for Standardization (ISO) 3822-1 with current amendments.
 - c. Supports will be used when sound and/or vibration transfer is a concern. Locations where acoustical supports will be provided and include but are not limited to partition walls between living units, tenant spaces, retail units, mechanical rooms and lobbies.
 - d. Support Products:
 - 1) Support to Wall Brace and Wall Stud Penetrations: HOLDRITE #261, #262, #263, and #264, or approved equivalent.
 - 2) Pipe Wrap for Pipe Clamps and Channel-Mounted Pipe Clamps: HOLDRITE #270, or approved equivalent.
 - 3) Pipe Wrap for Pipe Hangers: HOLDRITE #271, #272-2, and #272-4, or approved equivalent.
 - 4) Drop-Ear Fitting Support: HOLDRITE #265, or approved equivalent.
 - 5) Floor Riser Isolation Pads: HOLDRITE #275-T, or approved equivalent.
 - 6) Floor Isolation Pads (General Applications): HOLDRITE #274, #275, #276, and #278, or approved equivalent.
- O. Freestanding Roof Pipe Supports:
 - 1. Polyethylene high-density U.V. resistant quick "pipe" block with foam pad.
 - 2. Recommended installation is for pipe blocks to be freestanding.
 - 3. Piping 3-inches and larger mounted on block type supports.

2.03 WALL AND FLOOR SLEEVES

- A. Below Grade and High Water Table Areas:
 - 1. Modular Link Sealing System at Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal. Use a modular link sealing system at sleeves to continuously fill the annular space between the pipe and the wall opening. Provide Link-seal Type C unless otherwise noted. OS with S-316 stainless construction for continuous water/tank walls.
 - 2. Sleeves through concrete foundation walls and floors. Ductile iron pipe. Class 50 or 51 pipe conforming to ANSI/AWWA C151/A21.51, cement lined. Pipe sleeve will extend a minimum of 6-inches beyond outside perimeter of foundation. Final placement of sleeve will be confirmed with project's structural engineer. In areas with a high water table, provide AWWA C900, Class 235 plastic pipe in lieu of ductile iron pipe.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Insulating Caulking: Eagle or Pitcher Super 66 high temperature cement.
- D. Fabricated Accessories:
 - 1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 - 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide following minimum gauges for sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
 - b. Sleeve Sizes 5-inches to 6-inches: 16 gauge.
 - c. Sleeve Sizes 7-inches and Larger: 14 gauge.
 - d. Fire-Rated Safing Material:

- 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 lbs./cu.ft. density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
- 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.04 BUILDING ATTACHMENTS

- A. General: Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project Structural Engineer. Provide anchor bolts suitable for cracked concrete.
- B. Anchor Bolts:
 1. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 2. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 3. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
- C. Beam Clamps:
 1. MSS Type 19 and 23, wide throat, with retaining clip.
 2. Universal Side Beam Clamp: MSS Type 20.
- D. Powder-Actuated Drive Pin Fasteners:
 1. Powder-Actuated Drive-Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- E. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- F. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 2. Properties: Nonstaining, noncorrosive, and non-gaseous.
 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.05 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.
- D. Provide hot dipped galvanized components for items exposed to weather.

2.06 MISCELLANEOUS METAL AND MATERIALS

- A. Miscellaneous Metal: Provide miscellaneous metal items specified hereunder, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on Drawings or otherwise not shown on drawings, that are necessary for completion of the project. The Contractor is responsible for their design.
 1. Fabricate miscellaneous units to size, shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.

- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather.
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support piping.
- I. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Nonstaining, noncorrosive, and non gaseous.
 - 3. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

END OF SECTION

SECTION 22 05 48 - VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.
 - 1. Section 22 05 29 - Hangers and Supports for Plumbing Piping and Equipment
 - 2. Section 22 30 00 - Plumbing Equipment

1.03 REFERENCES AND STANDARDS

- A. References and standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Vibration Isolation:
 - a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
 - b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
 - 1) Equipment mounting holes.
 - 2) Dimensions.
 - 3) Isolation selected for each support point.
 - 4) Details of mounting brackets for isolator.
 - 5) Weight distribution for each isolator.
 - 6) Details of seismic snubbers.
 - 7) Code number assigned to each isolator.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Vibration Isolation:
 - a. Except for packaged equipment with integral isolators, single manufacturer will select and furnish isolation required.
 - b. Deflections indicated will be minimum actual static deflections for specific equipment supported.
 - c. Isolator Stability:
 - 1) Size springs of sufficient diameter to maintain stability of equipment being supported with minimum horizontal to vertical stiffness ratio not less than 1:1. Spring diameters will be not less than 0.8 of the compressed height at rated load.
 - 2) Springs will have minimum additional travel to solid equal to 50 percent of the rated deflection.
 - 3) Springs will support 200 percent of rated load when fully compressed without deformation or failure.
 - d. Maximum Allowable Vibration Levels: Peak vibration velocities not to exceed 0.08 in/sec. correct equipment operating at vibration velocities that exceed this criteria.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Vibration Isolation:
 - 1. Amber-Booth.
 - 2. California Dynamics Corporation.
 - 3. Mason Industries, Inc.
 - 4. Kinetics Noise Control.
 - 5. Vibro-Acoustics.
 - 6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
 - 7. Or approved equivalent.

2.02 VIBRATION ISOLATION

- A. Type 1 - Neoprene Pad: Rubber or neoprene waffle pads, single layer, 5/16-inch thick with pattern repeating on 1/2-inch centers; 40 to 50 durometer hardness; maximum loading 50 PSI, 1/4-inch thick steel load distribution plate. Mason Type SWM.
- B. Type 2 - Neoprene Mount: Double-deflection type, with steel or ductile-iron housing containing two separate and opposing, oil-resistant rubber or neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Minimum static deflection of 0.20-inches. Mason Type BR.
- C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators, factory drilled for bolting to structure, if needed, and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside, mounts with leveling bolts. Mason Type SLFH or Type SLF.
- D. Type 4 - Spring with Restraints: Laterally stable, open-spring isolators, factory drilled for bolting to structure and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside; mounts with leveling bolts; steel or cast iron housing for directional seismic snubbing with resilient vertical-limit stops. Mason Type SLR or SSLFH.
- E. Type 5 - Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression; designed for 30-degree angular movement before hanger-rod misalignment without binding; seismic rebound washer; 1-inch minimum deflection. Mason Type PC30N.
- F. Seismic Snubbers: Directional interlocking steel members restrained by one-piece molded neoprene bushing, minimum of 3/4-inch thick with minimum 1/8-inch air gap in all directions, capable of withstanding 3 times the rated load capacity. Mason Type Z-1225.

END OF SECTION

SECTION 22 05 53 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Tags
 - 3. Plastic Pipe Markers

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, submit Valve Schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals. Provide schedules organized as follows:
 - 1. Equipment Type:
 - a. Identification:
 - b. Background:
 - 1) Size:
 - 2) Color:
 - c. Lettering:
 - 1) Size:
 - 2) Color:

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 22, Plumbing Sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Plastic Nameplates:
 - 1. Brady Corporation
 - 2. Or approved equivalent.

- C. Tags:
 1. Brady Corporation
 2. Brimer
 3. Champion America Inc.
 4. Craftmark
 5. Seton Identification Products
 6. Or approved equivalent.
- D. Plastic Pipe Markers:
 1. Brady Corporation
 2. Brimer
 3. Champion America Inc.
 4. Craftmark
 5. Seton Identification Products
 6. Or approved equivalent.

2.02 PLASTIC NAMEPLATES

- A. Description: Engraving stock melamine plastic laminate 1/8-inch thick, engraved with engraver's standard letter style of the sizes and wording indicated.
 1. Letter Color: White.
 2. Letter Height: 1/2 inch (13 mm).
 3. Background Color: Black.
 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.
 6. Signage for hot water outlets on 140 degree F hot water systems not protected by ASSE 1070 mixing valves; hose bibbs, janitor sinks, and fixtures used by trained personnel.
 - a. Manufacturer's standard 1/8-inch thick engraved plastic laminate signage 4 by 4-inches.
 - b. Letter Color: Red.
 - c. Letter Height: 1/2 inch (13 mm).
 - d. Background Color: White.
 - e. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2-inch diameter.
- B. Metal Tags: Polished Brass with stamped letters; tag size minimum 1-1/2-inch diameter with smooth edges.
- C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7-inches.
 2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

2.04 PLASTIC PIPE MARKERS

- A. Color: Conform to ASME A13.1 and ANSI Z535.1.
- B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

END OF SECTION

SECTION 22 05 93 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Balancing water flow within distribution systems of all Division 22, Plumbing Sections, including sub-mains, branches, and terminals, to indicated quantities according to specified tolerances.
 - 2. Adjusting plumbing systems to provide indicated quantities.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of the activities and procedures specified in this Section.

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Acceptable Balance Firm:
 - a. General:
 - 1) Procure services of independent Testing, Adjusting, and Balancing (TAB) agency to balance, adjust and test water circulating. Minimum Experience: 5 years.
 - b. Industry Standards: Testing and Balancing will conform to NEBB, American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE), and American National Standards Institute (ANSI) as follows:
 - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting Balancing of Environmental Systems.
 - 2) ASHRAE: Comply with recommendations pertaining to measurements, instruments, and TAB.
 - c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.
 - 2. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
 - 3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
 - 4. Owner Witness: Perform tests in the presence of the Owners representative.
 - 5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
 - 6. Simultaneous Testing: Test observations by the Authority Having Jurisdiction (AHJ), the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
 - 7. Do not perform TAB work until plumbing equipment has been completely installed and is operating continuously as required.
 - 8. Conduct TAB with clean filters in place. Clean strainers prior to performing TAB.
 - 9. Agent Qualifications: Engage a TAB Agent certified by AABC or NEBB.

10. TAB Conference: Meet with the Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
 - a. Agenda Items: Include at least the following:
 - 1) Submittal distribution requirements.
 - 2) TAB plan.
 - 3) Work schedule and Project site access requirements.
 - 4) Coordination and cooperation of trades and subcontractors.
 - 5) Coordination of documentation and communication flow.
11. Certification of TAB Reports: Certify the TAB field data reports. This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
12. TAB Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
13. TAB Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
14. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
15. Instrumentation Type, Quantity, and Accuracy: As described in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."
16. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.07 DEFINITIONS

- A. Adjust: To regulate fluid flow rate at the equipment.
- B. Balance: To proportion flows within the distribution system, including sub mains, branches, and terminals, according to design quantities.
- C. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- D. Report Forms: Test data sheets for recording test data in logical order.
- E. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- F. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- G. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- H. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- I. TAB: Testing, Adjusting, and Balancing.
- J. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- K. Test: A procedure to determine quantitative performance of a system or equipment.

- L. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- M. AABC: Associated Air Balance Council.
- N. AMCA: Air Movement and Control Association.
- O. CTI: Cooling Tower Institute.
- P. NEBB: National Environmental Balancing Bureau.
- Q. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.08 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, controls installers, and other mechanics to operate systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Perform TAB after leakage and pressure tests on piping distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 PROJECT CONDITIONS

- A. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.

3.02 EXAMINATION

- A. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - 2. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- B. Examine approved submittal data of Plumbing systems and equipment.
- C. Examine equipment performance data including pump curves. 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.
- D. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
- E. Examine system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- F. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- G. Examine open-piping-system pumps to ensure absence of entrained air in the suction piping.
- H. Examine equipment for installation and for properly operating safety interlocks and controls.
- I. Examine automatic temperature system components to verify the following:
 - 1. Valves, and other controlled devices operate by the intended controller.
 - 2. Valves are in the position indicated by the controller.

3. Integrity of valves for free and full operation and for tightness of fully closed and fully open positions.
 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 5. Sensors are located to sense only the intended conditions.
 6. Sequence of operation for control modes is according to the Contract Documents.
 7. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
- J. Report deficiencies discovered before and during performance of TAB procedures.
- K. Beginning of work means acceptance of existing conditions.

3.03 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 1. Permanent electrical power wiring is complete.
 2. Systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Isolating and balancing valves are open and control valves are operational.
- C. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 1. Attendance is required by installers whose work will be tested, adjusted, or balanced.
- D. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.

3.04 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform TAB procedures on each system according to the procedures contained in AABC national standards or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.
- B. Cut insulation for pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
- C. Mark equipment settings with paint or other suitable, permanent identification material, including control positions, valve indicators and similar controls and devices, to show final settings.

3.05 ADJUSTMENT TOLERANCES

- A. Piping Systems: Adjust to within plus or minus 10 percent of design.

3.06 RECORDING AND ADJUSTING

- A. Field Logs: Maintain written logs including:
 1. Running log of events and issues.
 2. Discrepancies, deficient or uncompleted work by others.
 3. Contract interpretation requests.
 4. Lists of completed tests.
- B. Ensure recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. Mark on drawings locations where other critical measurements were taken and cross reference location in final report.

3.07 FUNDAMENTAL PROCEDURES FOR PIPING 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 approved pump flow rate. Correct variations that exceed plus or minus 10 percent.

- B. Prepare schematic diagrams of systems' "as-built" piping layouts.
- C. Prepare systems for TAB according to the following, in addition to the general preparation procedures specified above:
 - 1. Open manual valves for maximum flow.
 - 2. Check expansion tank liquid level, or air charge if bladder type.
 - 3. Check makeup-water-station pressure gauge for adequate pressure.
 - 4. Check flow-control valves for specified sequence of operation and set at design flow.
 - 5. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.

3.08 FINAL REPORT

- A. General: Computer printout in letter-quality font, on standard bond paper, in 3-ring binder, tabulated and divided into Sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
 - 1. Include a list of the instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to the certified field report data, include the following:
 - 1. Pump curves.
 - 2. Field test reports prepared by system and equipment installers.
 - 3. Other information relative to equipment performance, but do not include approved Shop Drawings and Product Data.
- D. General Report Data: In addition to the form titles and entries, include the following data in the final report, as applicable:
 - 1. Title page.
 - 2. Name and address of TAB Agent.
 - 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 Agent who certifies the report.
 - 10. Summary of contents, including the following:
 - a. Design versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - 11. Nomenclature sheets for each item of equipment.
 - 12. Notes to explain why certain final data in the body of reports vary from design values.
- E. Pump Test Reports: For pumps, include the following data. Calculate impeller size by plotting the shutoff head on pump curves.
 - 1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm (L/s).
 - g. Water pressure differential in feet of head or PSIG (kPa).
 - h. Required net positive suction head in feet of head or PSIG (kPa).
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor horsepower and rpm.

m. Voltage at each connection.

END OF SECTION

SECTION 22 07 00 - PLUMBING INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Type 1, Glass Wool Pipe Insulation
 - 2. Type 2, Flexible Elastomeric Insulation
 - 3. Type 5, Glass Wool Equipment Insulation
 - 4. Type 7, ADA Accessible Lavatory/Sink Insulation Kit
 - 5. Jacketing
 - 6. Accessories
 - 7. Pipe Fitting Insulation Covers

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
 - 3. 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.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements apply to this Section.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
 - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
 - 3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
 - 4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.07 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with requirements of current edition of UL "Pipe and Equipment Coverings".

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Type 1, Glass Wool Pipe Insulation:
 - 1. Owens-Corning
 - 2. Johns Manville
 - 3. Or approved equivalent.
- B. Type 2, Flexible Elastomeric Insulation:
 - 1. Insulation:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 - 2. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. K-Flex
 - c. Or approved equivalent.
 - 3. Paint:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
- C. Type 5, Glass Wool Equipment Insulation:
 - 1. Knauf
 - 2. Owens-Corning
 - 3. Johns Manville
 - 4. Or approved equivalent.
- D. Type 7, ADA Accessible Lavatory/Sink Insulation Kit:
 - 1. IPS/Truebro
 - 2. McGuire/Pro-Wrap
 - 3. Plumberex/Pro-Extreme
 - 4. Brocar Trap Wrap
 - 5. Or approved equivalent.
- E. Jacketing:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- F. Accessories:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- G. Pipe Fitting Insulation Covers:
 - 1. Zeston Johns Manville
 - 2. ITW Insulation Systems
 - 3. Or approved equivalent.

2.02 TYPE 1, GLASS WOOL PIPE INSULATION

- A. Glass Fiber: ASTM C547 Type I and IV; rigid molded, noncombustible.
 - 1. Thermal Conductivity Value: 0.27 BTU*in/(hr*sf°F) at 75 degrees F.

2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.03 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 1. Thermal Conductivity Value: 0.25 BTU*in/(hr*sf°F) at 75 degrees F.
 2. Maximum Service Temperature of 220 degrees F.
 3. Maximum Flame Spread: 25.
 4. Maximum Smoke Developed: 50 (3/4-inch thick and below).
 5. Connection: Waterproof vapor retarder adhesive as needed.
 6. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.
- C. Paint: Nonhardening high elasticity type, specifically manufactured as a protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.04 TYPE 5, GLASS WOOL EQUIPMENT INSULATION

- A. Flexible Glass Wool Blanket: ASTM C612; flexible.
 1. Thermal Conductivity Value: 0.24 BTU*in/(hr*sf°F) at 75 degrees F.
 2. Maximum Service Temperature: 450 degrees F.

2.05 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

- A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards meeting ASTM C1822. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Thermal conductivity; K = 1.17 (BTU*in/(hr*sf°F) at 75 degrees F mean temperature. Provide accessories as required for complete installation covering all exposed waste piping, water piping, stops and supplies. Color white.

2.06 JACKETING

- A. Canvas Jacket: UL listed fabric, 6 oz/sq.yd., plain weave cotton treated with dilute fire retardant lagging adhesive.
- B. Aluminum Jacket: 0.016-inch-thick sheet, smooth or embossed finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner. ASTM B 209, ASTM 1729, C1371.
- C. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth or corrugated finish. ASTM A 666
- D. Equipment Insulation Jacketing: Pre-sized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.

2.07 ACCESSORIES

- A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have same flame and smoke component ratings as insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide non-water soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.08 PIPE FITTING INSULATION COVERS

- A. PVC Plastic Fitting Covers: Schuller Zeston 2000, Knauf Proto Fitting or approved equivalent. One-piece molded type fitting covers and jacketing material, gloss white. Connections: Tacks; pressure sensitive color matching vinyl tape.

END OF SECTION

SECTION 22 10 00 - PLUMBING PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Buried Within 5-feet of Building
 - 2. Sanitary, Drainage (Rain/Stormwater) DWV Piping, Above Grade
 - 3. Pump Waste Pressure Piping (Pumped Discharge)
 - 4. Water Piping, Buried Within 5-feet of Building
 - 5. Hot and Cold Domestic Water Above Grade
 - 6. Condensate Piping
 - 7. Primer Piping
 - 8. Cleanouts

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G.
 - 2. California Standard AB 1953.
 - 3. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
 - 4. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
 - 5. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
 - 6. Manufacturer's Standards Society (MSS) for valving and support reference standard.
 - 7. American Water Works Association (AWWA) for Valving Assembly Standards.
 - 8. American Society of Sanitation Engineers (ASSE) for Valving Standards.
 - 9. American National Standards Institute (ANSI) for Piping Standards.
 - 10. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes".
 - 11. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. See component manufacturers listed in individual articles below.
- B. Cerro
- C. Tyler
- D. ADS
- E. Charlotte

- F. Elkhart
- G. Spears
- H. Nibco
- I. Orion
- J. American-USA
- K. Sioux Chief
- L. Mueller
- M. Or approved equivalent.
- N. Cleanouts:
 - 1. J.R. Smith
 - 2. Zurn
 - 3. Wade
 - 4. Watts
 - 5. Sioux Chief
 - 6. Or approved equivalent.
- O. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
 - 1. Hilti
 - 2. Proset
 - 3. Or approved equivalent.

2.02 GENERAL

- A. Provide pipe, tube and fittings of the same type, fitting requirements, grade, class and the size and weight indicated or required for each service, as indicated in other Division 22, Plumbing Specifications. Where type, grade, or class is not indicated, provide proper selection as determined by installer for installation requirements, and comply with governing regulations and industry standards.
- B. Manufactured materials delivered, new to the project site and stored in their original containers.
- C. Product Marking: Furnish each item with legible markings indicating name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

2.03 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540, Clamp-All Hi-Torq 125, Husky SD 4000, Mission HeavyWeight couplings.
- B. Copper Tube: ASTM B 306, DWV
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, ASTM B-828 and alloy Sn50 solder.
 - 3. Flux: ASTM B813-91, water soluble.
- C. Epoxy Coating:
 - 1. No-hub two-part epoxy coated cast iron soil pipe and fittings, certified to conform to ASTM A-888-11. Coating a minimum of 2.5 mil thickness on exterior and a minimum of 5.0 mil thickness on interior. Spray-on two part epoxy coating provides a superior coating. Test epoxy coated cast iron soil pipe and fittings for nonreactivity from 2-12pH for thirty days. Epoxy coating not to sag, cold flow or become soft.
 - 2. Coupling Assembly:

- a. Standard Duty: 310 series stainless steel couplings with 5/16-inch hex head screws of 305 stainless steel. ASTM 1277 or CISPI 310 Anaco, Mission, NewAge Casting (NAC), Tyler.
- b. Heavy Duty: 301 series stainless steel couplings with 5/16-inch hex head screws of 305 stainless steel. ASTM C 1540310 Anaco, Mission, NewAge Casting (NAC), Tyler.
- c. Coupling to have a polychloroprene (neoprene) based interior rubber sleeve conforming to ASTM C564.

2.04 SANITARY, DRAINAGE (RAIN/STORMWATER) DWV PIPING, ABOVE GRADE

- A. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Standard Duty: ASTM C1277 or CISPI 310.
- B. Copper Tube: ASTM B 306, DWV
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.05 PUMP WASTE PRESSURE PIPING (PUMPED DISCHARGE)

- A. Above Grade : Type "L" copper with solder joints.
- B. Below Grade: Type "L" copper with brazed joints.

2.06 WATER PIPING, BURIED WITHIN 5-FEET OF BUILDING

- A. Copper Pipe: ASTM B88, hard drawn, Type K (A).
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22 wrought copper and bronze.
 - 2. Joints: Brazed - BCuP2.
- B. Ductile Iron Pipe: AWWA C151/A21.51.
 - 1. Fittings: Ductile or gray iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with 3/4-inch diameter rods, mega lug type.

2.07 HOT AND COLD DOMESTIC WATER ABOVE GRADE

- A. Copper Tube: 3-inches and above. ASTM B88 (ASTM BA88m), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- B. Copper Tube: 2-1/2-inches and smaller. ASTM B88 (ASTM B88M), Type L (B), Drawn.
 - 1. Fittings: ASME B16.18 copper.
 - 2. Joints: ASTM B32, alloy Sn95 solder.
- C. Copper Tube: Water pressures up to 250 PSI gauge. ASTM B 88 (ASTM BA 88m), Type K (A), Drawn.
 - 1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
 - 2. Joints: Brazed BCuP2.
- D. Copper Tube: ASTM B88 (ASTM B88M), Type K (A), Drawn.
 - 1. Fittings: ASME B16.22, wrought copper.
 - 2. Joints: Roll grooved mechanical coupling. ASTM A536.

2.08 CONDENSATE PIPING

- A. Copper Tube: ASTM B 88 (ASTM B898M), Type K (A), L (B), or M (C).
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.
- B. Use chemical resistant piping for drainage of condensate from combustion fuel sources (such as condensing boilers and water heaters), as noted in this Section for area of application.

2.09 PRIMER PIPING

- A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.

- B. Below Ground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.
- C. Below Ground: Cross-linked polyethylene (PEX) and engineered plastic fittings.

2.10 CLEANOUTS

- A. Locate cleanouts as shown on Drawings and as required by local code. Cleanouts same size as pipe except that greater than 4-inches will not be required. Plastic components not allowed, except unless specifically noted.
- B. Types:
 - 1. Tile Floor Cleanouts: J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread, ABS plug and standard screws.
 - 2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame, round heavy-duty nickel bronze top, taper thread, ABS plug, carpet clamping device and standard screws.
 - 3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
 - 4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 with round heavy-duty nickel bronze top, taper thread and ABS plug with standard screws.
 - 5. Wall Cleanout: J. R. Smith 4472-U, countersunk bronze taper thread plug, stainless steel shallow cover and vandalproof screws.
 - 6. Outside Area Walks: J. R. Smith 4020-U with round heavy-duty nickel bronze top, taper thread, ABS plug and top secured with vandalproof screws. Install in 18- by 18- by 6-inch deep concrete pad flush with grade.

END OF SECTION

SECTION 22 30 00 - PLUMBING EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Domestic Circulation Pump with Variable Speed Drive

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Seismic anchor details and calculations signed and stamped by licensed California structural engineer with equipment data.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NSF 61, Annex G compliant.
 - 2. ISO 9001 Certified.
 - 3. IAPMO Low Lead Certification
 - 4. California Standard AB 1953
- C. Products approved for installation by state authorizing agency, no exceptions.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Domestic Circulation Pumps with Variable Speed Drive:
 - 1. Goulds Series 3SV-AIK9GO
 - 2. Grundfos
 - 3. Armstrong
 - 4. Or approved equivalent.

2.02 GENERAL

- A. Reference drawings for capacities and specific model numbers.

2.03 DOMESTIC CIRCULATION PUMP WITH VARIABLE SPEED DRIVE

- A. System: Domestic Hot Water Recirculation.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Pumps designed for high head in 125 degrees F and 230 PSI.
- D. Pumps rated for installation in potable hot water systems.
- E. Pumps in-line multistage type for installation in horizontal piping.
- F. Pump set up by factory for variable speed drive.

- G. Pump must be capable of being serviced without disturbing piping connections.
- H. Construction: 304 Stainless steel body and trim with casing and impeller rings, ceramic bushing, tungsten carbide shaft sleeve, cast iron NEMA motor adapter and motor shaft coupling and cast aluminum pump base or NPT connections, 230 PSI working pressure at maximum operating temperature of 250 degrees F.
- I. ODP Motor meets NEMA Specifications and size, voltage and enclosure.
- J. Each pump factory tested. Thoroughly cleaned and painted with at least one coat of high-grade machinery enamel prior to shipment.
- K. Recirc pumps are 100 percent redundant. Each pump operates for 12 hour period.
- L. Provide an ITT Bell and Gossett Technologic 500 Series Pump Logic Controller. Controller provides as recirc pump control panel. This is to be combination Pump Controller and Variable Frequency Drive in single enclosure. Provide fused disconnect switch with handle through cover, overload reset button, running lights, 24 hour timer, H-O-A switches with overload protection, control circuit transformer for 120V operation, single point electrical connection. Wiring between control panel and pump provided under Division 22, Plumbing. Reference Section 22 05 13, Common Motor Requirements for Plumbing Equipment, for details on variable speed drives.
- M. Provide Honeywell 115 volt aquastat for operation control.
- N. Coordinate location of unit and electrical characteristics with Division 26, Electrical work.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. General Plumbing Fixtures:
 - a. Enameled Steel Fixtures, White Only
 - b. Faucet Fittings
 - c. Shower Valves
 - d. Stainless Steel Fixtures
 - e. Thermostatic Mixing Valves
 - f. Trench Drains
 - 2. Carriers
 - 3. Catch Basins
 - 4. Drinking Fountains
 - 5. Electric Water Coolers
 - 6. Fixture Trim
 - 7. Floor Drains
 - 8. Floor Sinks
 - 9. Flushometers - Water Closet/Urinal
 - 10. Hose Bibbs
 - 11. Hub Drains
 - 12. Water Closet Seats
 - 13. Drain Boxes
 - 14. Water Supply Boxes

1.02 RELATED SECTIONS

- A. Contents of Division 22, Plumbing and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Comply with lead free (less than or equal to 0.25 percent) products in drinking water systems.
 - 2. NSF 61, Annex G, Drinking Water System Components, Compliant.
 - 3. ISO 9001, Quality Management Standard Certified.
 - 4. IAPMO Low Lead Certification.
 - 5. California Standard Assembly Bill AB 1953, No-Lead Law
 - 6. Provide fixtures, faucets and accessories to meet barrier free requirements of the governing code with respect to plumbing fixtures provided for the physically handicapped.
 - 7. Items approved for use by State of California.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. "Or approved equivalent" as defined in 22 00 00, Plumbing Basic Requirements. Substitution process requirements apply to approved equivalent products.
- B. General Plumbing Fixtures: See Schedule on Drawings for type.
 - 1. Enameled Steel Fixtures - White Only:
 - a. American Standard
 - b. Briggs
 - c. Crane
 - d. Eljer
 - e. Kohler
 - f. Universal-Rundle
 - g. Or approved equivalent.
 - 2. Faucet Fittings:
 - a. Private:
 - 1) Chicago
 - 2) Delta Commercial
 - 3) Moen
 - 4) Speakman
 - 5) Symmons
 - 6) T&S Brass
 - 7) Or approved equivalent.
 - b. Public:
 - 1) American Standard
 - 2) Chicago
 - 3) Delta Commercial
 - 4) Moen Commercial
 - 5) Sloan
 - 6) Symmons
 - 7) T & S Brass
 - 8) Or approved equivalent.
 - 3. Shower Valves:
 - a. Acorn
 - b. Chicago
 - c. Delta
 - d. Moen
 - e. Powers
 - f. Symmons
 - g. Or approved equivalent.
 - 4. Stainless Steel Fixtures:
 - a. Elkay
 - b. Haws
 - c. Just
 - d. Or approved equivalent.
 - 5. Thermostatic Mixing Valves:
 - a. Bradley
 - b. Powers
 - c. Symmons
 - d. Holby
 - e. Or approved equivalent.
 - 6. Trench Drains:
 - a. Channel-Slope

- b. JR Smith
 - c. PolyDrain
 - d. Polycast
 - e. Quazite
 - f. Zurn
 - g. Or approved equivalent.
- C. Carriers:
 - 1. JR Smith
 - 2. Zurn
 - 3. Or approved equivalent.
- D. Catch Basins:
 - 1. Lynch
 - 2. Or approved equivalent.
- E. Drinking Fountain:
 - 1. Elkay
 - 2. Halsey-Taylor
 - 3. Haws
 - 4. Oasis
 - 5. Sunroc
 - 6. Or approved equivalent.
- F. Electric Water Coolers:
 - 1. Elkay
 - 2. Halsey-Taylor
 - 3. Haws
 - 4. Oasis
 - 5. Sunroc
 - 6. Or approved equivalent.
- G. Fixture Trim:
 - 1. McGuire
 - 2. Dearborn Brass
 - 3. Oatey
 - 4. Or approved equivalent.
- H. Floor Drains:
 - 1. Mifab
 - 2. Sioux Chief
 - 3. Smith
 - 4. Wade
 - 5. Watts
 - 6. Zurn
- I. Floor Sinks:
 - 1. Commercial Enameling
 - 2. Mifab
 - 3. Sioux Chief
 - 4. Smith
 - 5. Wade
 - 6. Watts
 - 7. Zurn
 - 8. Or approved equivalent.
- J. Flushometers - Water Closet/Urinal:
 - 1. Delaney
 - 2. Sloan

3. Zurn
 4. Or approved equivalent.
- K. Hose Bibbs:
1. Chicago
 2. JR Smith
 3. Mifab
 4. Wade
 5. Woodford
 6. Zurn
 7. Or approved equivalent.
- L. Hub Drains:
1. JR Smith
 2. Zurn
 3. Or approved equivalent.
- M. Water Closet Seats:
1. Bemis
 2. Or approved equivalent.
- N. Drain Boxes:
1. Sioux Chief
 2. Or approved equivalent.
- O. Water Supply Boxes:
1. Sioux Chief
 2. Or approved equivalent.

2.02 GENERAL PLUMBING FIXTURES

- A. Review substitution request requirements in Division 01, General Requirements and 22 00 00, Plumbing General Requirements.
- B. Reference Architectural Details for mounting height and location of fixtures.
- C. Provide factory fabricated fixtures of type, style and material indicated on the plumbing fixture connection schedule shown on the Drawings. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, or required for complete installation. Where more than one type is indicated, selection is installer's option; but, fixtures of same type must be furnished by a single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.
- D. Provide fixtures complete with fittings, supports, fastening devices, bolt caps, faucets, valves, traps, stops and appurtenances.
- E. Plumbing Fixture Thermostatic Mixing Valves:
 1. Lavatories provide ASSE 1070 compliant mixing valves or multiple lavatories served by a single ASSE 1070 compliant mixing valve.
 2. Sinks serviced with a single ASSE 1070 mixing valve or multiple sinks served by a single ASSE 1070 mixing valve.
 3. Commercial kitchen handsinks provide ASSE 1070 mixing valves.
 4. Janitor sinks or process/maintenance type sinks do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.
 5. Hot water hose bibbs do not require ASSE 1070 mixing valves if operated by trained personnel. Provide signage per Section 22 05 53, Identification for Plumbing Piping and Equipment.

2.03 CARRIERS

- A. Wall Hung Water Closets:

1. Vertical: Zurn Z-1204-N4-XH-50 or Z-1204-ND4-XH-50 (JR Smith 230y-MS4-M12/230DY-M54-M12). Adjustable vertical load siphon jet with 300 lb. capacity.
 2. Horizontal: Zurn ZE-1203-N4-XH-50 or ZE-1203-ND4-XH-50 (JR Smith 220 R/L-Y-M54-M12/220DY-M5-M12). Adjustable horizontal siphon jet with 300 lb. load capacity.
- B. Wall Hung Urinal: Zurn Z-1218-WS. (JR Smith 637). Coupling type or plate type with bearing plate 200 lb. capacity.
 - C. Wall Hung Lavatory: Zurn Z-1231 (D). (JR Smith 700). Concealed arm or Plate type, 250 lb. capacity.
 - D. Wall Hung Service Sink: Zurn Z-1218. (JR Smith 913/914). Coupling type. 300 lb. capacity.
 - E. Wall Hung Drinking Fountain: Zurn Z-1225-BL (JR Smith 834-97-98). Plate type. 300 lb. capacity.
 - F. Wall Hung Flushing Rim Clinic Sink: Zurn Z-1217 (JR Smith 0915-Y4-98). Coupling Type. 300 lb. capacity.
 - G. 750 lb. Carrier for Water Closet:
 1. Adjustable vertical type.
 2. Adjustable horizontal type.

2.04 CATCH BASINS

- A. See Schedule on Drawings for type.

2.05 DRINKING FOUNTAINS

- A. See Schedule on Drawings for type.

2.06 ELECTRIC WATER COOLERS

- A. See Schedule on Drawings for Type.

2.07 FIXTURE TRIM

- A. Traps: Provide heavy duty commercial grade traps on fixtures except fixtures with integral traps. Exposed traps will be chromium plated cast brass or 17 gauge chromium plated brass tubing.
 1. Sink: McGuire 8912-C-DF.
 2. Lavatory: McGuire 8902-C-DF.
- B. Supplies and Stops: Lead free heavy duty commercial grade, chrome plated with brass stems. Stops: T-handle or Loose Key type.
 1. Lavatory: McGuire LFH 2165 CK
 2. Sink: McGuire LFH 2167 LK
 3. Water Closets: McGuire
- C. Lavatory Grid Strainer: McGuire 155A.
- D. Sink Grid Strainer: McGuire 152N.
- E. Shower Grid Strainer: McGuire 1266.
- F. Sink Basket Strainer: McGuire 151.
- G. Trim barrier-free wrap for P-traps and supplies by McGuire, Pro-Wrap, Plumberex or True-bro.
- H. Escutcheons: McGuire wrought brass deep bell.
- I. Wax Rings and Toilet Bolts: WM Harvey No Seep No. 1 053065-N.

2.08 FLOOR DRAINS

- A. See Schedule on Drawings for types.

2.09 FLOOR SINKS

- A. See Schedule on Drawings for types.
- B. Plastic components are not allowed.

2.10 FLUSHOMETERS - WATER CLOSET/URINAL

A. See Schedule on Drawings for types.

2.11 HOSE BIBBS

A. See Schedule on Drawings for types.

2.12 HUB DRAINS

A. See Schedule on Drawings for type.

2.13 WATER CLOSET SEATS

A. See Schedule on Drawings for type.

2.14 DRAIN BOXES

A. See Schedule on Drawings for Type.

B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

2.15 WATER SUPPLY BOXES

A. See Schedule on Drawings for Type.

B. Provide fire rated ASTM E-84 rated boxes where required by building construction.

END OF SECTION

SECTION 23 00 00 - HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC REQUIREMENTS

PART 1 - GENERAL

1.01 DESIGN-BUILD SUMMARY OF WORK

- A. Work included in 23 00 00 applies to Division 23, Heating, Ventilating and Air Conditioning (HVAC) work to provide materials, labor, tools, permits and incidentals to make HVAC systems ready for Owner's use for proposed project.

1.02 DESIGN-BUILD INSTRUCTIONS

- A. This document is issued to give Bidders a basis for preparing a proposal to design and install complete HVAC systems for this project.
- B. Alternates to this Document may be offered as a separate proposal.
- C. Bidder to submit the following information with the Proposal:
 - 1. Preliminary drawings indicating major equipment locations and preliminary layout.
 - 2. Description of systems, manufacturer and method of control.
 - 3. List of materials proposed for systems which are applicable to this project.
 - 4. Any other information which the bidder considers pertinent in evaluating the proposal.

1.03 DESIGN-BUILD DESIGN APPROACH

- A. Use this Specification as a guide for design/engineering requirements, workmanship and materials or construction. Utilize design-build concept throughout construction phase of project.
- B. Investigate and be apprised of applicable codes, rules, and regulations as enforced by Authority Having Jurisdiction (AHJ).
- C. Visit the Site of the proposed construction. Verify and inspect the existing site to determine conditions that affect this work.

1.04 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Related Work Specified Elsewhere:
 - 1. Contents of Section apply to Division 23 Specifications.
 - 2. Requirements of Section are a minimum for Division 23 Sections, unless otherwise stated in each Section, in which case that Section's requirements take precedence.
- B. Design Criteria: Per the Basis of Design Narrative.
- C. Calculations:
 - 1. Submit heating and cooling load calculations per ASHRAE Standards for each HVAC zone.
 - 2. Submit natural gas sizing calculations.
 - 3. Submit structural calculations for seismic bracing of HVAC equipment and piping. Structural calculations to be signed by a Registered Engineer in the State of California.

1.05 SECTION INCLUDES

- A. Work included in 23 00 00, HVAC Basic Requirements applies to Division 23, HVAC work to provide materials, labor, tools, permits, incidentals, and other services to provide and make ready for Owner's use of heating, ventilating and air conditioning systems for proposed project.
- B. Contract Documents include, but are not limited to, Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Drawings, Addenda, Owner/Architect Agreement, and Owner/Contractor Agreement. Confirm requirements before commencement of work.
- C. Definitions:
 - 1. Provide: To furnish and install, complete and ready for intended use.
 - 2. Furnish: Supply and deliver to project site, ready for unpacking, assembly and installation.

3. Install: Includes unloading, unpacking, assembling, erecting, installation, applying, finishing, protecting, cleaning and similar operations at project site as required to complete items of work provided.
4. Approved or Approved Equivalent: To possess the same performance qualities and characteristics and fulfill the utilitarian function without any decrease in quality, durability or longevity. For equipment/products defined by the Contractor as "equivalent", substitution requests must be submitted to Engineer for consideration, in accordance with Division 01, General Requirements, and approved by the Engineer prior to submitting bids for substituted items.
5. Authority Having Jurisdiction (AHJ): Indicates reviewing authorities, including local fire marshal, Owner's insurance underwriter, Owner's Authorized Representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.06 RELATED SECTIONS

- A. Contents of Section applies to Division 23, HVAC Contract Documents.
- B. Related Work:
 1. Additional conditions apply to this Division including, but not limited to:
 - a. Specifications including Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - b. Drawings
 - c. Addenda
 - d. Owner/Architect Agreement
 - e. Owner/Contractor Agreement
 - f. Codes, Standards, Public Ordinances and Permits

1.07 REFERENCES AND STANDARDS

- A. References and Standards per Division 01, General Requirements, individual Division 23, HVAC Sections and those listed in this Section.
- B. Codes to include latest adopted editions, including current amendments, supplements and local jurisdiction requirements in effect as of the date of the Contract Documents, of/from:
 1. State of California:
 - a. CBC - California Building Code
 - b. CEC - California Electrical Code
 - c. CEC T24 - California Energy Code Title 24
 - d. CFC - California Fire Code
 - e. CMC - California Mechanical Code
 - f. CPC - California Plumbing Code
 - g. CSFM - California State Fire Marshal
 - h. DSA - Division of State Architect Regulations and Requirements
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ABA - Architectural Barriers Act
 2. ABMA - American Bearing Manufacturers Association
 3. ADA - Americans with Disabilities Act
 4. AHRI - Air-Conditioning Heating & Refrigeration Institute
 5. AMCA - Air Movement and Control Association
 6. ANSI - American National Standards Institute
 7. ASCE - American Society of Civil Engineers
 8. ASHRAE - American Society of Heating, Refrigeration and Air-Conditioning Engineers
 9. ASHRAE Guideline 0, The Commissioning Process
 10. ASME - American Society of Mechanical Engineers
 11. ASPE - American Society of Plumbing Engineers
 12. ASSE - American Society of Sanitary Engineering

13. ASTM - ASTM International
14. AWWA - American Water Works Association
15. CFR - Code of Federal Regulations
16. CGA - Compressed Gas Association
17. CISPI - Cast Iron Soil Pipe Institute
18. EPA - Environmental Protection Agency
19. ETL - Electrical Testing Laboratories
20. FM - FM Global
21. GAMA - Gas Appliance Manufacturers Association
22. HI - Hydraulic Institute Standards
23. IAPMO - International Association of Plumbing & Mechanical Officials
24. IFGC - International Fuel Gas Code
25. ISO - International Organization for Standardization
26. MSS - Manufacturers Standardization Society
27. NEC - National Electric Code
28. NEMA - National Electrical Manufacturers Association
29. NFPA - National Fire Protection Association
30. NFGC - National Fuel Gas Code
31. NRCA - National Roofing Contractors Association
32. NSF - National Sanitation Foundation
33. OSHA - Occupational Safety and Health Administration
34. SMACNA - Sheet Metal and Air Conditioning Contractors' National Association, Inc.
35. TEMA - Tubular Exchanger Manufacturers Association
36. TIMA - Thermal Insulation Manufacturers Association
37. UL - Underwriters Laboratories, Inc.

D. See Division 23, HVAC individual Sections for additional references.

1.08 SUBMITTALS

- A. See Division 01, General Requirements for Submittal Procedures as well as specific individual Division 23, HVAC Sections.
- B. Provide drawings in format and software release equal to the design documents. Drawings to be the same sheet size and scale as the Contract Documents.
- C. In addition:
 1. "No Exception Taken" constitutes that review is for general conformance with the design concept expressed in the Contract Documents for the limited purpose of checking for conformance with information given. Any action is subject to the requirements of the Contract Documents. Contractor is responsible for the dimensions and quantity and will confirm and correlate at the job site, fabrication processes and techniques of construction, coordination of the work with that of all other trades, and the satisfactory performance of the work.
 2. Provide product submittals and shop drawings in electronic format only. Electronic format must be submitted via zip file via e-mail. For electronic format, provide one file per division containing one bookmarked PDF file with each bookmark corresponding to each Specification Section. Arrange bookmarks in ascending order of Specification Section number. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. All transmissions/submissions to be submitted to Architect. At Contractor's option, four separate submittals may be provided, consisting of long lead items, underground/site work, building work, and building automation system. Deviations will be returned without review.
 3. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 23, HVAC Sections.
 4. Identify/mark each submittal in detail. Note what differences, if any, exist between the submitted item and the specified item. Failure to identify the differences will be considered

cause for disapproval. If differences are not identified and/or not discovered during the submittal review process, Contractor remains responsible for providing equipment and materials that meet the Specifications and Drawings.

- a. Label submittal to match numbering/references as shown in Contract Documents. Highlight and label applicable information to individual equipment or cross out/remove extraneous data not applicable to submitted model. Clearly note options and accessories to be provided, including field installed items. Highlight connections by/to other trades.
 - b. Include technical data, installation instructions and dimensioned drawings for products, fixtures, equipment and devices installed, furnished or provided. Reference individual Division 23, HVAC Specification Sections for specific items required in product data submittal outside of these requirements.
 - c. Provide pump curves, operation characteristics, capacities, ambient noise criteria, etc. for equipment.
 - d. For vibration isolation of equipment, list make and model selected with operating load and deflection.
 - e. See Division 23, HVAC individual Sections for additional submittal requirements outside of these requirements.
5. Maximum of two reviews of submittal package. Arrange for additional reviews and/or early review of long-lead items; Bear costs of these additional reviews at Engineer's hourly rates. Incomplete submittal packages/submittals will be returned to contractor without review.
 6. Resubmission Requirements: Make corrections or changes in submittals as required, and in consideration of Engineer's comments. Identify Engineer's comments and provide an individual response to each of the Engineer's comments. Cloud changes in the submittals and further identify changes which are in response to Engineer's comments.
 7. Structural/Seismic: Provide weights, dimensions, mounting requirements and like information required for mounting, seismic bracing, and support. Indicate manufacturer's installation and support requirements to meet Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Division 01 and in Structural documents.
 8. Trade Coordination: Include physical characteristics, electrical characteristics, device layout plans, wiring diagrams, and connections as required by Division 23, HVAC Coordination Documents. For equipment with electrical connections, furnish copy of approved submittal for inclusion in Division 26, Electrical submittals.
 9. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
 10. Substitutions and Variation from Basis of Design:
 - a. The Basis of Design designated product establishes the qualities and characteristics for the evaluation of any comparable products by other listed acceptable manufacturers if included in this Specification or included in an approved Substitution Request as judged by the Design Professional.
 - b. If substitutions and/or equivalent equipment/products are being proposed, it is the responsibility of parties concerned, involved in, and furnishing the substitute and/or equivalent equipment to verify and compare the characteristics and requirements of that furnished to that specified and/or shown. If greater capacity and/or more materials and/or more labor is required for the rough-in, circuitry or connections than for the item specified and provided for, then provide compensation for additional charges required for the proper rough-in, circuitry and connections for the equipment being furnished. No additional charges above the Base Bid, including resulting charges for work performed under other Divisions, will be allowed for such revisions. Coordinate with the requirements of "Submittals". For any product marked "or approved equivalent", a substitution request must be submitted to Engineer for approval prior to purchase, delivery or installation.

11. Shop Drawings: Provide coordinated shop drawings which include physical characteristics of all systems, equipment, ductwork and piping layout plans, and control wiring diagrams. Reference individual Division 23, HVAC Specification Sections for additional requirements for shop drawings outside of these requirements.
 - a. Provide Shop Drawings indicating access panel locations for items that require Code or maintenance access, size and elevation for approval prior to installation.
12. Samples: Provide samples when requested by individual Sections.
13. Resubmission Requirements:
 - a. Make any corrections or change in submittals when required. Provide submittals as specified. The engineer will not be required to edit and/or interpret the Contractor's submittals. Indicate changes for the resubmittal in a cover letter with reference to page(s) changed and reference response to comment. Cloud changes in the submittals.
 - 1) Resubmit for review until review indicates no exception taken or make "corrections as noted".
 - 2) When submitting drawings for Engineers re-review, clearly indicate changes on drawings and "cloud" any revisions. Submit a list describing each change.
14. Operation and Maintenance Manuals, Owner's Instructions:
 - a. Submit, at one time, electronic files (PDF format) of manufacturer's operation and maintenance instruction manuals and parts lists for equipment or items requiring servicing. Include valve charts. Submit data when work is substantially complete and in same order format as submittals. Include name and location of source parts and service for each piece of equipment.
 - 1) Include copy of approved submittal data along with submittal review letters received from Engineer. Data to clearly indicate installed equipment model numbers. Delete or cross out data pertaining to other equipment not specific to this project.
 - 2) Include copy of manufacturer's standard Operations and Maintenance for equipment. At front of each tab, provide routine maintenance documentation for scheduled equipment. Include manufacturer's recommended maintenance schedule and highlight maintenance required to maintain warranty. Furnish list of routine maintenance parts, including part numbers, sizes, quantities, relevant to each piece of equipment: belts, motors, lubricants, and filters.
 - 3) Include Warranty per Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Sections.
 - 4) Include product certificates of warranties and guarantees.
 - 5) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub assemblies.
 - 6) Include copy of startup and test reports specific to each piece of equipment.
 - 7) Include copy of final air and water systems balancing log along with pump, fan and distribution system operating data.
 - 8) Include commissioning reports.
 - 9) Include copy of valve charts/schedules.
 - 10) Engineer will return incomplete documentation without review. Engineer will provide one set of review comments in Submittal Review format. Contractor must arrange for additional reviews; Contractor to bear costs for additional reviews at Engineer's hourly rates.
 - b. Thoroughly instruct Owner in proper operation of equipment and systems. Where noted in individual Sections, training will include classroom instruction with applicable training aids and systems demonstrations. Field instruction per Section 23 00 00, HVAC Basic Requirements Article titled "Demonstration".

- c. Copies of certificates of code authority inspections, acceptance, code required acceptance tests, letter of conformance and other special guarantees, certificates of warranties, specified elsewhere or indicated on Drawings.
15. Record Drawings:
- a. Maintain at site at least one set of drawings for recording "As-constructed" conditions. Indicate on drawings changes to original documents by referencing revision document, and include buried elements, location of cleanouts, and location of concealed mechanical items. Include items changed by field orders, supplemental instructions, and constructed conditions.
 - b. Record Drawings are to include equipment and fixture/connection schedules, control dampers, fire smoke dampers, fire dampers, valves, bottom of pipe, duct and equipment elevations and dimensioned locations for all distribution systems (hydronic and air). Invert elevations and dimensioned locations for underground systems below grade to 5-feet outside building that accurately reflect "as constructed or installed" for project.
 - c. At completion of project, input changes to original project CAD Drawings and make one set of black-line drawings created from CAD Files in version/release equal to contract drawings. Submit CAD disk and drawings upon substantial completion.
 - d. See Division 23, HVAC individual Sections for additional items to include in record drawings.

1.09 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State and Federal codes, and other applicable laws and regulations. Where code requirements are at variance with Contract Documents, meet code requirements as a minimum requirement and include costs necessary to meet these in Contract. Machinery and equipment are to comply with OSHA requirements, as currently revised and interpreted for equipment manufacturer requirements. Install equipment provided per manufacturer recommendations.
- B. Whenever this Specification calls for material, workmanship, arrangement or construction of higher quality and/or capacity than that required by governing codes, higher quality and/or capacity take precedence.
- C. Drawings are intended to be diagrammatic and reflect the Basis of Design manufacturer's equipment. They are not intended to show every item in its exact dimensions, or details of equipment or proposed systems layout. Verify actual dimensions of systems (i.e., piping) and equipment proposed to assure that systems and equipment will fit in available space. Contractor is responsible for design and construction costs incurred for equipment other than Basis of Design, including, but not limited to, architectural, structural, electrical, HVAC, fire sprinkler, and plumbing systems.
- D. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- E. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- F. Provide products that are UL listed.
- G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.
- H. ASME Compliance: ASME listed water heaters and boilers with an input of 200,000 BTUH and higher, hot water storage tanks which exceed 120 gallons, and hot water expansion tanks which are connected to ASME rated equipment or required by code or local jurisdiction.
- I. Provide safety controls required by National Boiler Code (ASME CSD 1) for boilers and water heaters with an input of 400,000 BTUH and higher.

1.10 WARRANTY

- A. Provide written warranty covering the work for a period of one year from date of Substantial Completion in accordance with Division 00, Contracting and Procurement Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Sections under this Division can require additional and/or extended warranties that apply beyond basic warranty under Division 01, General Requirements and the General Conditions. Confirm requirements in all Contract Documents.

1.11 COORDINATION DOCUMENTS

- A. Prior to construction, coordinate installation and location of HVAC equipment, ductwork, grilles, diffusers, piping, equipment, fire sprinklers, plumbing, cable trays, lights, and electrical services with architectural and structural requirements, and other trades (including ceiling suspension, and tile systems), and provide maintenance access requirements. Coordinate with submitted architectural systems (i.e. roofing, ceiling, finishes) and structural systems as submitted, including footings and foundation. Identify zone of influence from footings and ensure systems are not routed within the zone of influence.
- B. Advise Architect in event a conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- C. Verify in field exact size, location, invert, and clearances regarding existing material, equipment and apparatus, and advise Architect of discrepancies between that indicated on Drawings and that existing in field prior to installation related thereto.
- D. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.02 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Base contract upon furnishing materials as specified. Materials, equipment, and fixtures used for construction are to be new, latest products as listed in manufacturer's printed catalog data and are to be UL or ETL approved or have adequate approval or be acceptable by State, County, and City authorities.
- B. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- C. Hazardous Materials:
 - 1. Comply with local, State of California, and Federal regulations relating to hazardous materials.
 - 2. Comply with Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for this project relating to hazardous materials.
 - 3. Do not use any materials containing a hazardous substance. If hazardous materials are encountered, do not disturb; immediately notify Owner and Architect. Hazardous materials will be removed by Owner under separate contract.

PART 3 - EXECUTION

3.01 ACCESSIBILITY AND INSTALLATION

- A. Confirm Accessibility and Installation requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

- B. Install equipment having components requiring access (i.e., drain pans, drains, control operators, valves, motors and vibration isolation devices) so that they may be serviced, reset, replaced or recalibrated by service people with normal service tools and equipment. Do not install equipment in obvious passageways, doorways, scuttles or crawlspaces which would impede or block intended usage.
- C. Install equipment and products complete as directed by manufacturer's installation instructions including all appurtenances recommended in manufacturer's installation instructions, at no additional charge to Owner. Obtain installation instructions from manufacturer prior to rough-in of equipment and examine instructions thoroughly. When requirements of installation instructions conflict with Contract Documents, request clarification from Architect prior to proceeding with installation. This includes proper installation methods, sequencing and coordination with other trades and disciplines.
- D. Earthwork:
 - 1. Confirm Earthwork requirements in Contract Documents. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Perform excavation, dewatering, shoring, bedding, and backfill required for installation of work in this Division in accordance with related earthwork Sections. Contact utilities and locate existing utilities prior to excavation. Repair any work damaged during excavation or backfilling.
 - b. Excavation: Do not excavate under footings, foundation bases, or retaining walls.
 - c. Provide protection of underground systems. Review the project Geotechnical Report for references to corrosive or deleterious soils which will reduce the performance or service life of underground systems materials.
- E. Firestopping:
 - 1. Confirm Firestopping requirements in Division 07, Thermal and Moisture Protection. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - a. Coordinate location and protection level of fire and/or smoke rated walls, ceilings, and floors. When these assemblies are penetrated, seal around piping, ductwork and equipment with approved firestopping material. Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
 - 1. Provide installation of piping systems coordinated to account for expansion and contraction of piping materials and building, as well as anticipated settlement or shrinkage of building. Install work to prevent damage to piping, equipment, and building and its contents. Provide piping offsets, loops, seismic flexible joints, expansion joints, sleeves, anchors or other means to control pipe movement and minimize forces on piping. Verify anticipated settlement and/or shrinkage of building with Project Structural Engineer. Verify construction phasing, type of building construction products and rating for coordinating installation of piping systems.
 - 2. Include provisions for servicing and removal of equipment without dismantling piping.
- G. Plenums:
 - 1. Plenums: Materials within plenums shall be noncombustible or shall have a flame spread index of not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723. Immediately notify Architect / Engineer of any discrepancy.

3.02 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Structural documents, Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment, and individual Division 23 HVAC Sections.
- B. Piping and Ductwork:

1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- C. Provide means to prohibit excessive motion of mechanical equipment during earthquake.

3.03 REVIEW AND OBSERVATION

- A. Confirm Review and Observation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Notify Architect, in writing, at following stages of construction so that they may, at their option, visit site for review and construction observation:
1. Underground system installation prior to backfilling.
 2. Prior to covering walls.
 3. Prior to ceiling cover/installation.
 4. After major equipment is installed.
 5. When main systems, or portions of, are being tested and ready for inspection by AHJ.
- C. Final Punch:
1. Prior to requesting a final punch visit from the Engineer, request from Engineer the Mechanical Precloseout Checklist, complete the checklist confirming completion of systems' installation, and return to Engineer. Request a final punch visit from the Engineer, upon Engineer's acceptance that the mechanical systems are ready for final punch.
 2. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.04 CONTINUITY OF SERVICE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. During remodeling or addition to existing structures, while existing structure is occupied, current services to remain intact until new construction, facilities or equipment is installed.
 2. Prior to changing over to new service, verify that every item is thoroughly prepared. Install new piping and ductwork, and wiring to point of connection. Where existing systems are being utilized, clean existing distribution systems (ductwork, piping, fans, air handlers) prior to connecting new ductwork or piping.
 3. Coordinate transfer time to new service with Owner. If required, perform transfer during off peak hours. Once changeover is started, pursue to its completion to keep interference to a minimum.
 - a. If overtime is necessary, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. Organize work to minimize duration of power interruption.

3.05 CUTTING AND PATCHING

- A. Confirm Cutting and Patching requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
1. Proposed floor cutting/core drilling/sleeve locations to be approved by Project Structural Engineer. Submit proposed locations to Architect/Project Structural Engineer. Where slabs are of post tension construction, perform x-ray scan of proposed penetration locations and submit scan results including proposed penetration locations to Project Structural Engineer/Architect for approval. Where slabs are of waffle type construction, show column cap extent and cell locations relative to proposed penetration(s).
 2. Cutting, patching and repairing for work specified in this Division including plastering, masonry work, concrete work, carpentry work, and painting included under this Section will be performed by skilled craftsmen of each respective trade in conformance with appropriate Division of Work.

3. Additional openings required in building construction to be made by drilling or cutting. Use of jack hammer is specifically prohibited. Patch openings in and through concrete and masonry with grout.
4. Restore new or existing work that is cut and/or damaged to original condition. Patch and repair specifically where existing items have been removed. This includes repairing and painting walls, ceilings, etc. where existing conduit and devices are removed as part of this project. Where alterations disturb lawns, paving, and walks, surfaces to be repaired, refinished and left in condition matching existing prior to commencement of work.
5. Additional work required by lack of proper coordination will be provided at no additional cost to the Owner.

3.06 EQUIPMENT SELECTION AND SERVICEABILITY

- A. Replace or reposition equipment which is too large or located incorrectly to permit servicing, at no additional cost to Owner.
- B. Maintain design intent where equipment other than as shown as Basis of Design in Contract Documents is provided. Where equipment requires ductwork or piping arrangement, controls/control diagrams, or sequencing different from that indicated in Contract Documents, provide at no additional cost to Owner.

3.07 DELIVERY, STORAGE AND HANDLING

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 1. Handle materials delivered to project site with care to avoid damage. Store materials on site inside building or protected from weather, dirt and construction dust. Insulation and lining that becomes wet from improper storage and handling to be replaced before installation. Products and/or materials that become damaged due to water, dirt, and/or dust as a result of improper storage to be replaced before installation.
 2. Protect equipment and pipe to avoid damage. Close pipe openings with caps or plugs. Keep motors and bearings in watertight and dustproof covers during entire course of installation.
 3. Protect bright finished shafts, bearing housings and similar items until in service.

3.08 DEMONSTRATION

- A. Confirm Demonstration requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Upon completion of work and adjustment of equipment and test systems, demonstrate to Owner's Authorized Representative, Architect and Engineer that equipment furnished and installed or connected under provisions of these Specifications functions in manner required. Provide field instruction to Owner's Maintenance Staff as specified in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- C. Manufacturer's Field Services: Furnish services of a qualified person at time approved by Owner, to instruct maintenance personnel, correct defects or deficiencies, and demonstrate to satisfaction of Owner that entire system is operating in satisfactory manner and complies with requirements of other trades that may be required to complete work. Complete instruction and demonstration prior to final job site observations.

3.09 CLEANING

- A. Confirm Cleaning requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.

- B. Upon completion of installation, thoroughly clean exposed portions of equipment, removing temporary labels and traces of foreign substances. Throughout work, remove construction debris and surplus materials accumulated during work.

3.10 INSTALLATION

- A. Confirm Installation requirements in Division 00, Procurement and Contracting Requirements, Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Install equipment and fixtures in accordance with manufacturer's installation instructions, plumb and level and firmly anchored to vibration isolators. Maintain manufacturer's recommended clearances.
- C. Start up equipment, in accordance with manufacturer's start-up instructions, and in presence of manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.
 - 1. Do not place equipment in sustained operation prior to initial balancing of HVAC systems.
- D. Provide miscellaneous supports/metals required for installation of equipment, piping and ductwork.

3.11 PAINTING

- A. Confirm Painting requirements in Division 01, General Requirements and Division 09, Finishes. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Ferrous Metal: After completion of work, thoroughly clean and paint exposed supports constructed of ferrous metal surfaces in mechanical rooms, i.e., hangers, hanger rods, equipment stands, with one coat of black asphalt varnish for exterior or black enamel for interior, suitable for hot surfaces.
 - 2. After acceptance by Authority Having Jurisdiction (AHJ), In a mechanical room, on roof or other exposed areas, machinery and equipment not painted with enamel to receive two coats of primer and one coat of rustproof enamel, colors as selected by Architect.
 - 3. See individual equipment Specifications for other painting.
 - 4. Structural Steel: Repair damage to structural steel finishes or finishes of other materials damaged by cutting, welding or patching to match original.
 - 5. Piping and Ductwork: Clean, primer coat and paint exposed piping and ductwork on roof or at other exterior locations with two coats paint suitable for metallic surfaces and exterior exposures. Color selected by Architect.
 - 6. Covers: Covers such as manholes, cleanouts and the like will be furnished with finishes which resist corrosion and rust.

3.12 ACCEPTANCE

- A. Confirm requirements in Division 00, Procurement and Contracting Requirements and Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. System cannot be considered for acceptance until work is completed and demonstrated to Architect that installation is in strict compliance with Specifications, Drawings and manufacturer's installation instructions, particularly in reference to following:
 - a. Testing and Balancing Reports
 - b. Cleaning
 - c. Operation and Maintenance Manuals
 - d. Training of Operating Personnel
 - e. Record Drawings
 - f. Warranty and Guaranty Certificates
 - g. Start-up/Test Document
 - h. Commissioning Reports

- B. Reference State of California requirements for specific testing procedures and documentation requirements. Comply with State and local governmental standards and requirements for testing, and completion and submittal of appropriate forms as required by Title 24 and local governmental agencies related to this work.

3.13 FIELD QUALITY CONTROL

- A. Confirm Field Quality Control requirements in Division 01, General Requirements, Section 23 00 00, HVAC Basic Requirements and individual Division 23, HVAC Sections.
- B. Tests:
 - 1. Conduct tests of equipment and systems to demonstrate compliance with requirements specified. Reference individual Specification Sections for required tests. Document tests and include in Operation and Maintenance Manuals.
 - 2. During site evaluations by Architect or Engineer, provide appropriate personnel with tools to remove and replace trims, covers, and devices so that proper evaluation of installation can be performed.

3.14 LETTER OF CONFORMANCE

- A. Provide Letter of Conformance, copies of manufacturers' warranties and extended warranties with a statement that HVAC items were installed in accordance with manufacturer's recommendations, UL listings and FM Global approvals. Include Letter of Conformance, copies of manufacturers' warranties and extended warranties in Operation and Maintenance Manuals.

3.15 ELECTRICAL INTERLOCKS

- A. Where equipment motors are to be electrically interlocked with other equipment for simultaneous operation, utilize equipment wiring diagrams to coordinate with electrical systems so that proper wiring of equipment involved is affected.

3.16 TEMPORARY HEATING, COOLING AND HUMIDITY CONTROL

- A. Provide temporary heating, cooling, controls, humidification and dehumidification as required to facilitate the construction of the project. Size and select temporary system based on the requirements of the various trades during construction. This includes, but is not limited to, drywall, case work, wood flooring and wood finishes that are subject to warping. Size and install system to prevent mold growth. Coordinate the location of the temporary system. The house system can be used. Develop a procedure for how the house system will be used including a sketch depicting the house system, how filtration will be used to prevent construction debris from entering the system and how often the filters will be changed, how the ductwork will be cleaned after use to ensure a clean system is turned over to the Owner and how the units are sized. Submit this procedure to the Mechanical Engineer for review. Follow National Air Duct Cleaners Association (NADCA) duct cleaning procedures and guidelines. Warranties for the house system, if new, to commence when the Owner moves in if house system is used as the means to maintain the climate within the building during construction. Include this warranty requirement in the original bid or proposal amount. Coordinate and provide any temporary power, controls, ductwork, piping, plumbing anchorage, miscellaneous steel and structural supports required to support the temporary system. Installation of the system to comply with all applicable codes and be acceptable to the Authority Having Jurisdiction (AHJ).

END OF SECTION

SECTION 23 05 13 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Starters
 - 2. Shaft Grounding
 - 3. Motors

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NEMA Premium Efficiency
 - 2. Energy Policy Act (EPACT), latest applicable version(s) for minimum motor efficiencies.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
 - 2. Electrical components and materials to be UL and ETL listed/labeled as suitable for location and use.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. For motors 50 HP and larger, provide 5-year manufacturer's limited warranty from date of substantial completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Starters:
 - 1. Cerus
 - 2. Eaton Electrical
 - 3. General Electric
 - 4. Siemens
 - 5. Schneider Electric/Square D
 - 6. Or approved equivalent.
- B. Shaft Grounding:
 - 1. Shaft Grounding Inc.
 - 2. Aegis SGR Bearing Protection Ring
 - 3. Or approved equivalent.
- C. Motors:
 - 1. Lincoln Motor

2. Century Electric Motors (formerly A.O. Smith Electrical Products)
3. Baldor Electric
4. General Electric
5. Toshiba
6. Exception: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
7. Or approved equivalent.

2.02 STARTERS

- A. Single Phase Motors:
 1. Manual across-the-line starting switch having toggle-operated switch pilot running light and built-in thermal overload device with heating element rated not more than 115 percent motor full load current indicated on name plate of motor to be protected. Surface mount starters. Provide NEMA-1 enclosure.
 2. Overload relays to be melting alloy type with a replaceable control circuit module. Thermal units to be interchangeable. Starter to be non operative if thermal unit is removed.
 3. Single-phase motors with automatic controls. Provide motor-rated relay with coils rated for control voltage.
- B. Starters up to Size 8 to be suitable for the addition of a minimum of three external auxiliary contacts (normally open or normally closed). Contactor, coils, and relays to perform the control functions of the associated equipment and control sequence.
- C. Three Phase Motors up to and Including 15 HP:
 1. Provide enclosed type magnetic across-the-line starter with thermal overload and undervoltage protection.
 2. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified. Then provide "Hand-Off-Auto" selector switch.
 3. Starters for 3-phase motors to have overload protection in each of the three legs, with external manual reset.
 4. Unless indicated on Drawings or in Specifications, furnish motor starters with a neon pilot light. Neon lights are required for exhaust fan switches.
 5. Equip starters with integral transformer and coil for control circuit. Coordinate coil voltage with control voltage.
- D. For Three Phase Motors Greater than 15 HP:
 1. Provide combination starter and fused safety disconnect integral in the same enclosure. Utilize Type 'RK' or 'L' fuses. Provide fuse block with rejection type fuse holders. Size fuses per motor manufacturer's recommendations.
 2. Provide a solid-state reduced voltage starter, consisting of power section, one-piece removable printed circuit logic board and field wiring interface terminals. Logic board uses quick disconnect plug-in connectors for current transformers inputs, line-and-load voltage inputs, SCR gate firing output circuits and status panel. 3-phase current sensing via current transformers. Class 10 electronic overload protection.
 3. Motor starters to include the following protections:
 - a. Inverse time running overcurrent protection.
 - b. 250 percent to 500 percent current limit adjustment.
 - c. Minimum and maximum voltage adjustments.
 - d. Voltage stability adjustment.
 - e. Single-phase protection with built-in short-time delay.
 - f. Undervoltage protection with built-in short time delay.
 - g. MOV surge suppression protection of SCRs rated 10 percent above the rated voltage.
 - h. Phase sequence protection.
 4. Display: Door-mounted status LCD alphanumeric or LED display indicating run, undervoltage, phase loss, phase current unbalance, overcurrent trip, overtemperature, current limit, end of ramp, and incorrect phase rotation.

5. Enclosure: NEMA 12. Operator: "Start-Stop" pushbutton, except where automatic control is indicated on Drawings or specified, then provide "Hand-Off-Auto" selector switch
6. Input/Output Relays: Provide relays as required to provide the control sequence.
7. UL 508 listed.

2.03 SHAFT GROUNDING

- A. Variable Speed Motor Shaft Grounding: Shaft grounding ring; solid ring type.
- B. Provide shaft grounding assembly on motors controlled by variable frequency drive. Shaft grounding device to be in the form of brush that resides on the motor shaft. Brush assembly shall be capable of tolerating misalignment and maintaining rotating contact throughout the motors life.
- C. Material: Material used in the grounding assembly shall be stable material commonly used within industry that is not believed to constitute a hazardous material under Occupational Safety & Health Administration (OSHA) regulations.
- D. Brushes: Specifically developed carbon compounds of sustained performance with wear life expectancy of 3 years minimum.
- E. Seals: Sealed type to keep contaminants from entering the shaft grounding system in wet or severe environment applications.
- F. Shaft Grounding Assembly: For clean room air handling systems, use the type that contains the wear products within a special enclosure within the shaft grounding system.

2.04 MOTORS

- A. Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 40 degrees C environment.
 3. Design for temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, and motor enclosure type.
 4. Built-in thermal overload protection or externally protected with separate over-load with low-voltage release or lock-out. Quick trip device on hermetically sealed motors.
 5. Service Factor: 1.15 for poly-phase motors except 1.25 for motors associated with shaft pressurization system fans and 1.35 for single phase motors.
 6. Efficiency: Provide NEMA Premium Efficiency motors.
 7. Motors used in conjunction with variable speed drives: Variable torque type matched for the full operating range of the variable frequency drive. As a minimum, motors to have Class F insulation, winding insulation rated for 1000 Volts and insulated bearings to prevent high frequency ground path. Loads not-to-exceed 80 percent of nameplate rating
- B. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- C. Wiring Terminations:
 1. Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Coordinate conductor sizes with Division 26, Electrical. Enclose terminal lugs in terminal box sized to NFPA 70, threaded for conduit.
 2. For fractional horsepower motors where connection is made directly, provide conduit connection in end frame.
- D. Single Phase Power, Split Phase Motors:
 1. Starting Torque: Less than 150 percent of full load torque.
 2. Starting Current: Up to seven times full load current.
 3. Breakdown Torque: Approximately 200 percent of full load torque.
 4. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve or ball bearings.

5. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- E. Single Phase Power, Permanent-Split Capacitor Motors:
1. Starting Torque: Exceeding one fourth of full load torque.
 2. Starting Current: Up to six times full load current.
 3. Multiple Speed: Through tapped windings.
 4. Open Drip-proof or Enclosed Air Over Enclosure: Class A (50 degrees C temperature rise) insulation, minimum 1.0 Service Factor, prelubricated sleeve or ball bearings, automatic reset overload protector.
- F. Single Phase Power, Capacitor Start Motors:
1. Starting Torque: Three times full load torque.
 2. Starting Current: Less than five times full load current.
 3. Pull-up Torque: Up to 350 percent of full load torque.
 4. Breakdown Torque: Approximately 250 percent of full load torque.
 5. Motors: Capacitor in series with starting winding; provide capacitor-start/capacitor-run motors with two capacitors in parallel with run capacitor remaining in circuit at operating speeds.
 6. Drip-proof Enclosure: Class A (50 degrees C temperature rise) insulation, NEMA Service Factor, prelubricated sleeve bearings.
 7. Enclosed Motors: Class A (50 degrees C temperature rise) insulation, 1.0 Service Factor, prelubricated ball bearings.
- G. Three Phase Power, Squirrel Cage Motors:
1. Starting Torque: Between 1 and 1-1/2 times full load torque.
 2. Starting Current: Six times full load current.
 3. Power Output, Locked Rotor Torque, Breakdown or Pull Out Torque: NEMA Design B characteristics.
 4. Design, Construction, Testing, and Performance: Conform to NEMA MG 1 for Design B motors.
 5. Insulation System: NEMA Class B or better. Use class F insulation when motors are controlled by a VFD.
 6. Testing Procedure: In accordance with IEEE 112. Load test motors to determine free from electrical or mechanical defects in compliance with performance data.
 7. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
 8. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors imbedded in motor windings and epoxy encapsulated solid state control relay for wiring into motor starter.
 9. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA STD 9, L-10 life of 200,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
 10. Sound Power Levels: To NEMA MG 1.
 11. Weatherproof Epoxy Treated Motors: Epoxy coat windings with rotor and starter surfaces protected with epoxy enamel; bearings double shielded with waterproof non-washing grease.
 12. Nominal Efficiency: Meet or exceed NEMA Premium Efficiency rating when tested in accordance with IEEE 112.
 13. Nominal Power Factor: Minimum at full load and rated voltage when tested in accordance with IEEE 112.

END OF SECTION

SECTION 23 05 19 - METERS AND GAUGES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Pressure Gauges
 - 2. Thermometers
 - 3. Dial Thermometers
 - 4. Separable Sockets
 - 5. Thermometer Wells
 - 6. Duct Thermometer Support Flanges
 - 7. Differential and Filter Pressure Gauges
 - 8. Pressure-Gauge Fittings
 - 9. Test Plugs

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Maintenance Materials:
 - a. Extra gauge Oil for Inclined Manometers: One Bottle.
 - b. Extra Pressure Gauges: One.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Pressure Gauges:
 - 1. Tserice Model 600CB.
 - 2. Dwyer Instruments, Inc.
 - 3. Moeller Instrument Co., Inc.
 - 4. Omega Engineering, Inc.
 - 5. Or approved equivalent.
- B. Thermometers:
 - 1. Tserice Model BX9.
 - 2. Ashcroft
 - 3. Weiss
 - 4. Marshaltown
 - 5. Weksler
 - 6. Or approved equivalent.
- C. Dial Thermometers:

1. Terice Model 80742.
 2. Ashcroft
 3. Weiss
 4. Marshaltown
 5. Weksler
 6. Or approved equivalent.
- D. Separable Sockets:
1. Kimray
 2. Weiss
 3. Terice
 4. Or approved equivalent.
- E. Thermometer Wells:
1. Ashcroft
 2. Omega
 3. Weiss
 4. Or approved equivalent.
- F. Duct Thermometer Support Flanges:
1. Terice
 2. Ashcroft
 3. Weiss
 4. Marshaltown
 5. Weksler
 6. Or approved equivalent.
- G. Differential and Filter Pressure Gauges:
1. Orange Gauges
 2. Midwest
 3. Or approved equivalent.
- H. Pressure-Gauge Fittings:
1. Omega
 2. Weiss
 3. Terice
 4. Or approved equivalent.
- I. Test Plugs:
1. Petes Plug
 2. Or approved equivalent.

2.02 PRESSURE GAUGES

- A. ASME B40.100, phosphor-bronze bourdon type, dry type.
1. Case: Cast aluminum, stem-mounted, flangeless.
 2. Size: 4-1/2 inch (115 mm) diameter.
 3. Window: Clear glass.
 4. Connector: Brass.
 5. Scale: White aluminum with black graduation and markings.
 6. Pointer: Black, adjustable.
 7. Mid-Scale Accuracy: One percent.
 8. Scale: Psi.

2.03 THERMOMETERS

- A. Adjustable Angle: Red-or blue-appearing organic liquid in glass: ASTM E 1; lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device; adjustable 360 degrees in horizontal plane, 180 degrees in vertical plane.
1. Size: 9-inch scale.

2. Window: Acrylic.
3. Scale: Aluminum, white background, black graduations and markings.
4. Stem: 3/4-inch NPT brass (aluminum for installation in air ducts).
5. Accuracy: 2 percent, per ASTM E 77.
6. Calibration: 0-160 with 2 Degrees F. graduations.

2.04 DIAL THERMOMETERS

- A. ASTM E 1, cast aluminum case, vapor or liquid actuated with brass or copper bulb, copper or bronze braided capillary, white with black markings and black pointer, glass lens, adjustable 360 degrees in horizontal plane. 180 degrees in vertical plane.
 1. Size: 4-1/2-inch diameter dial.
 2. Lens: Clear glass.
 3. Length of Capillary: Minimum 6-feet (for remote reading if required).
 4. Accuracy: 2 percent.
 5. Calibration: 2 Degrees F. graduations.

2.05 SEPARABLE SOCKETS

- A. Description: Fitting with protective socket for installation in threaded pipe fitting to hold fixed thermometer stem.
 1. Material: Brass, for use in copper piping.
 2. Material: Stainless steel, for use in steel piping.
 3. Extension-Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation. Omit extension neck for sockets for piping not insulated.
 4. Insertion Length: To extend to center of pipe.
 5. Cap: Threaded, with chain permanently fastened to socket.
 6. Heat Transfer Fluid: Oil or graphite.

2.06 THERMOMETER WELLS

- A. Description: Fitting with protective well for installation in threaded pipe fitting to hold test thermometer.
 1. Material: Brass for use in copper piping.
 2. Material: Stainless steel, for use in steel piping.
 3. Extension Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation. Omit extension neck for wells for piping not insulated.
 4. Insertion Length: To extend to center of pipe.
 5. Cap: Threaded, with chain permanently fastened to socket.
 6. Heat Transfer Fluid: Oil or graphite.

2.07 DUCT THERMOMETER SUPPORT FLANGES

- A. Description: Flanged fitting bracket for mounting in hole of duct, with threaded end for attaching thermometer.
 1. Extension Neck Length: Nominal thickness of 2-inches, but not less than thickness of exterior insulation.
 2. Insertion-Neck Length: Nominal thickness of 2-inches, but not less than thickness of insulation lining.

2.08 DIFFERENTIAL AND FILTER PRESSURE GAUGES

- A. Service: Air and non-combustible, compatible gases (Natural Gas option available.)
- B. Wetted Materials: Consult factory.
- C. Housing: Die cast aluminum case and bezel, with acrylic cover. Exterior finish is coated gray to withstand 168 hour salt spray corrosion test.
- D. Accuracy: Plus or minus 2 percent of full scale throughout range at 70 degrees F.
- E. Pressure Limits: Minus 20 Hg to 15 PSIG.
- F. Overpressure: Relief plug opens at approximately 25 PSIG standard gauges only.

- G. Temperature Limits: 20 to 140 degrees F.
- H. Size: 4-inch diameter dial face.
- I. Mounting Orientation: Diaphragm in vertical position. Consult factory for other position orientation.
- J. Process Connections: 1/8-inch female NPT duplicate high and low pressure taps, one pair side and one pair back.
- K. Standard Accessories: Two 1/8-inch NPT plugs for duplicate pressure taps, two 1/8-inch pipe thread to rubber tubing adapter and three flush mounting adapters with screws.

2.09 PRESSURE-GAUGE FITTINGS

- A. Valves: NPS 1/4 (DN8) brass or stainless-steel needle type.
- B. Syphons: NPS 1/4 (DN8) coil of brass turbine with threaded ends.
- C. Snubbers: ASME B40.5, NPS 1/4 (DN8) brass bushing with corrosion-resistant porous-metal disc of material suitable for system fluid and working pressure.

2.10 TEST PLUGS

- A. Description: Nickel-plated, brass-body test plug in NPS 1/2 (DN15) fitting.
- B. Body: Length as required to extend beyond insulation.
- C. Pressure Rating: 500 PSIG (3450 kPa) minimum.
- D. Core Inserts: One or two self-sealing valves, suitable for inserting 1/8-inch OD probe from dial-type thermometer or pressure gauge.
- E. Core Material for Air, Water, Oil and Gas: 20 to 200 degrees F (Minus 7 to plus 93 Degrees Celsius), chlorosulfonated polyethylene synthetic rubber.
- F. Test Plug Cap: Gasketed and threaded cap, with retention chain or strap.
- G. Test Kit: Pressure gauge and adapter with probe, two bimetal dial thermometers, and carrying case.
 - 1. Pressure Gauge and Thermometer Ranges: Approximately two times the system's operating conditions.

END OF SECTION

SECTION 23 05 23 - GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Balancing Valves
 - 2. Ball Valves
 - 3. Swing Check Valves
 - 4. Wafer Check Valves

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Source Limitations for Valves: Obtain each type of valve from a single source and from a single manufacturer.
- B. Valves, General:
 - 1. Apollo
 - 2. Armstrong
 - 3. ASCO
 - 4. Cla-Val
 - 5. Conbraco
 - 6. Crane
 - 7. Clow
 - 8. Griswold
 - 9. Hammond
 - 10. Hays
 - 11. Jenkins
 - 12. Josam
 - 13. Kennedy
 - 14. Milwaukee
 - 15. Mueller
 - 16. Nibco
 - 17. Red-White Valve
 - 18. Smith
 - 19. Stockham
 - 20. Tour Anderson
 - 21. Wade

22. Watts
 23. Wilkins
 24. Zurn
 25. Or approved equivalent.
- C. Balancing Valves:
1. Griswold
 2. Hays
 3. Armstrong CBV
 4. Tour Anderson
 5. Or approved equivalent.
- D. Ball Valves:
1. See Valves General above.
 2. NSF Valves:
 - a. Clow
 - b. Kennedy
 - c. Nibco
 - d. Or approved equivalent.
- E. Swing Check Valves:
1. See Valves General above.
- F. Wafer Check Valves:
1. See Valves General above.

2.02 VALVES - GENERAL

- A. General:
1. Sizes: Unless otherwise indicated, provide valves of same size as upstream pipe size.
 2. Operators: Provide handwheels, fastened to valve stem, for valves other than quarter-turn. Provide lever handle for quarter-turn valves 6 inches and smaller. Provide gear operators for quarter-turn valves 8 inches and larger and plug valves 5 inches and larger. Provide chain-operated sheaves and chains for overhead valves installed over 5 feet above finished floor.
 3. Valve Identification: Manufacturer's name (or trademark) and pressure rating clearly marked on valve body.
- B. Valves in Insulated Piping: With 2-inch stem extension and 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 and memory stops that are fully adjustable after insulation is applied.
 - a. Basis of Design Product: Subject to compliance with requirements. Provide NIBCO NIB-SEAL handle extension or comparable product by one of the following.
 - 1) Conbraco Industries, Inc.: Apollo Div.
- C. Valve-End Connections:
1. Flanged: With flanges according to ASME B16.1 for iron valves, ASME B16.5 for steel valves.
 2. Grooved: With grooves according to AWWA C606.
 3. Solder Joint: With sockets according to ASME B16.18.
 4. Threaded: With thread according to ASME B1.20.1.
- D. Valve Bypass and Drain Connections: MSS SP-45.
- E. Building Service:
1. Shutoff and Isolation Valves:
 - a. Pipe Sizes 3 Inches and Smaller: Ball valve.
 2. Drain Service: Ball valves.
 3. Strainer Blow-Off: Ball valve.

4. Check Valves: Swing or Wafer.

2.03 BALANCING VALVES

- A. Maximum 125 PSIG System Working Water Pressure.
- B. Manual Set Balancing Valves:
 1. Valves are to be of the "Y" pattern, equal percentage globe-style and provide three functions:
 - a. Precise flow measurement.
 - b. Precision flow balancing.
 - c. Positive drip-tight shutoff.
 2. Valve to provide multi-turn, 360 degree adjustment with micrometer type indicators located on the valve handwheel. Valves have a minimum of five full 360 degree handwheel turns. 90 degree style ball valves are not acceptable. Valve handle to have hidden memory feature, which will provide a means for locking the valve position after the system is balanced. Valves to be furnished with precision machined venturi built into the valve body to provide highly accurate flow measurement and flow balancing. The venturi to have two 1/4-inch threaded brass metering ports with check valves and gasketed caps located on the inlet side of the valve. The valve body, stem and plug to be brass. The handwheel to be high-strength resin.
 3. 2-1/2 Inches and Larger: Valve body to be either cast iron with integrated cast iron flanges (2-1/2-inch to 12-inch) or ductile iron with industrial standard grooved ends (2-1/2-inch to 12-inch). Valve stem and plug disc to be bronze with handwheel that permits multi-turn adjustments. Sizes 2-1/2-inch and 3-inch: five turns; sizes 4-inch to 6-inch: 6 turns; sizes 8-inch to 10-inch: 12 turns; and size 12-inch: 14 turns. Provide flange adapters to prevent rotation.
- C. Automatic Balance Valve:
 1. 1/2 Inch and Larger: Construction and attachment style as required by piping system. Internal working parts and removable flow cartridge to be stainless steel. Valves be factory set and automatically limit flow to specified capacities with 5 percent plus or minus accuracy over entire operating pressure differential.

2.04 BALL VALVES

- A. Ball valves on brazed piping are to be three-piece.
- B. 2-1/2 Inches and Smaller: MSS SP-110, 400-600 PSI, two-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 77CLF 100 Series two-piece.
- C. 3 Inches and Larger: MSS SP-110, 400-600 PSI, three-piece full port ball configuration, bronze body, extended soldered ends for copper pipe and threaded ends for iron pipe, lead-free brass or stainless steel ball, lead-free brass stem, Teflon seat, extended steel handle. Apollo 82-100/82A 140 Series three-piece.
- D. Full Port Ball Valve: 2- to 4-inch ductile iron, ASTM A536, micro finish steel chrome plated or stainless steel ball and stem. TFE seats, 600 PSI.

2.05 SWING CHECK VALVES

- A. 2 Inches and Smaller: Class 125, bronze body, horizontal swing, regrinding type, Y-pattern, renewable disc. Nibco 413. MSS SP-80, Type 4.
- B. 2-1/2 Inches and Larger: Class 125, iron body, bolted bonnet, horizontal swing, renewable seat and disc, flanged ends. Nibco F918. MSS SP-71, Type 1.
- C. Check Valve: Horizontal installation. Working pressure to 300 PSI. Ductile body, ASTM A536, and stainless clapper, EPDM, nitrile or optional viton bumper and bonnet seals. Stainless wetted parts.

2.06 WAFER CHECK VALVES

- A. Twin disc, Class 125 spring actuated designed to be installed with gaskets between two standard Class 125 flanges. 200 PSI, cast iron body, aluminum bronze disc. Nibco W-920-W.
- B. Check Valve: PPS coated ductile iron body, ASTM A536, aluminum bronze nonslamming disc, stainless steel spring and shaft. Rubber seat for intended service.

END OF SECTION

SECTION 23 05 29 - HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Hangers and Supports for HVAC Piping, Ductwork and Equipment
 - 2. Wall and Floor Sleeves
 - 3. Building Attachments
 - 4. Flashing
 - 5. Miscellaneous Metal and Materials

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASCE 7-10, Minimum Design Loads for Buildings and Other Structures.
 - 2. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 - 3. Install ductwork and piping per SMACNA's requirements.
 - 4. Hanger spacing installation and attachment to meet all manufacturer's requirements and MSS SP-58.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Welding:
 - a. Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications".
 - 2. Welding for Hangers:
 - a. Qualify procedures and personnel according to AWS D9.1, Sheet Metal Welding Code for duct joint and seam welding.
 - 3. Engineering Responsibility:
 - a. Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, duct support equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
 - 1) Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of hangers and supports that are similar to those indicated for this Project in material, design, and extent.
 - 4. Manufacturers regularly engaged in the manufacture of bolted metal framing support systems, whose products have been in satisfactory use in similar service for not less than 10 years.
 - 5. Support systems to be supplied by a single manufacturer.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

- A. Provide pipe, ductwork and equipment hangers and supports in accordance with the following:
 - 1. When supports, anchorages, and seismic restraints for equipment, and supports, anchorages, and seismic restraints for conduit, piping, and ductwork are not shown on the Drawings, the contractor is responsible for their design.
 - 2. Connections to structural framing not to introduce twisting, torsion, or lateral bending in the framing members. Provide supplementary steel as required.
- B. Engineered Support Systems:
 - 1. Support frames such as pipe racks or stanchions for piping, ductwork, and equipment which provide support from below.
 - 2. Equipment, ductwork and piping support frame anchorage to supporting slab or structure.
- C. Provide channel support systems, for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- D. Provide heavy-duty steel trapezes for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- E. Provide seismic restraint hangers and supports for piping, ductwork and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 23 05 48, Vibration and Seismic Controls for HVAC Equipment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Hangers and Supports for HVAC Piping, Ductwork and Equipment:
 - 1. Anvil International
 - 2. B-Line Systems, Incorporated
 - 3. Erico Company, Incorporated
 - 4. Nelson-Olsen Incorporated
 - 5. Rilco Manufacturing Company, Incorporated
 - 6. Snappitz Thermal Pipe Shield Manufacturing
 - 7. Unistrut Corporation
- B. Wall and Floor Sleeves:
 - 1. Thunderline Corporation "Link Seal".
 - 2. Or approved equivalent.
- C. Building Attachments:
 - 1. Anchor-It
 - 2. Gunnebo Fastening Corporation
 - 3. Hilti Corporation
 - 4. ITW Ramset/Red Head
 - 5. Masterset Fastening Systems, Incorporated

2.02 HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

- A. Hanger Rods: Hanger rods continuously threaded or threaded ends only in concealed spaces and threaded ends only in exposed spaces; finish electro-galvanized or cadmium-plated in concealed spaces and prime painted in exposed spaces; sizes per MSS.

- B. Hanger Rod Couplings: Anvil Figure 136, B-Line Figure B3220, or approved equivalent; malleable iron rod coupling with elongated center sight gap for visual inspection; to have same finish as hanger rods.
- C. Channel Hanging System:
 - 1. Framing members No. 12 gauge formed steel channels, 1-5/8-inch square, conforming to ASTM A570 GR33, one side of channel to have a continuous slot within turned lips; framing nut with grooves and spring 1/2-inch size, conforming to ASTM 675 GR60; screws conforming to ASTM A307; fittings conforming to ASTM A575; parts enamel painted or electro-galvanized.
 - 2. Concrete Inserts: Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- D. Continuous Concrete Insert: Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- E. Pipe Hangers:
 - 1. Pipe Rings for Hanger Rods:
 - a. Pipe Sizes 2-inches and Smaller: Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent.
 - b. Pipe Sizes 2-1/2-inches and Larger: Clevis type hangers with adjustable nuts on rod, UL listed. Anvil figure 260, Erico 400, or approved equivalent.
 - c. Pipe hangers to have same finish as hanger rods.
- F. Pipe Saddles and Shields:
 - 1. Factory fabricated saddles or shields under piping hangers and supports for insulated piping.
 - 2. Size saddles and shields for exact fit to mate with pipe insulation. 1/2 round, 18 gauge, minimum 12-inches in length (4-inch pipe and larger to be three times longer than pipe diameter).
- G. Riser Clamps: Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.
- H. Pipe Slides: Anvil, reinforced Teflon slide material (3/32-inch minimum thickness) bonded to steel; highly finished steel or stainless steel contact surfaces to resist corrosion; 60-80 PSI maximum active contact surface loading; steel parts 3/16-inch minimum thickness; attachment to pipe and framing by welding.
- I. Pipe Guides:
 - 1. Furnish and install pipe guides on continuous runs where pipe alignment must be maintained. Minimum two on each side of expansion joints, spaced per manufacturer's recommendations for pipe size. Fasten guides securely to pipe and structure. Contact with chilled water pipe not to permit heat to be transferred in sufficient quantity to cause condensation on any surface.
 - 2. Furnish and install guides approximately four pipe diameters (first guide) and 14 diameters (second guide) away from each end of expansion joints. Guides are not to be used as supports and are in addition to other pipe hangers and supports.
- J. Pipe Roller Hangers: Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- K. Below Ground Pipe Supports:
 - 1. Pipe Hangers All Sizes: Adjustable Clevis type, Federal Specification WW-H-171 (Type 1), UL listed, stainless steel Type 304. MSS Type 1. Erico 406.
 - 2. Rod: 5/8-inch stainless steel Type 18-8.
 - 3. Eyebolt: Stainless steel Type 18-8.
 - 4. Nuts and Washers: Stainless steel Type 18-8.
- L. Thermal Hanger Shield Inserts:
 - 1. 100-PSI (690-kPa) minimum compressive strength calcium silicate insulation, encased in sheet metal shield or polyisocyanurate rigid foam exceeding the load bearing weight of the pipe at the hanger point with a PVC vapor barrier.

2. Material for Cold Piping: Water-repellent-treated, ASTM C533, Type I calcium silicate with vapor barrier or polyisocyanurate rigid foam with a PVC vapor barrier.
 3. Material for Hot Piping: Water-repellent-treated ASTM C533, Type 1 calcium silicate or polyisocyanurate rigid foam with a PVC vapor barrier.
 4. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 5. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 6. Insert Length: Extend 2-inches beyond sheet metal shield for piping operating below ambient air temperature.
 7. Thermal Hanger Shield Insulation Operating Temperature: Meet or exceed fluid temperature in pipe.
- M. Freestanding Roof Supports: Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.03 WALL AND FLOOR SLEEVES

- A. Below Grade or High Water Table Areas:
 1. "Link-Seal" Pipe Sleeves: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.
 2. Provide Type S unless otherwise noted.
- B. Pre-Engineered Firestop Pipe Penetration Systems: UL listed assemblies for maintaining fire rating of piping penetrations through fire-rated assemblies. Comply with ASTM E814.
- C. Fabricated Accessories:
 1. Steel Pipe Sleeves: Fabricate from Schedule 40 black or galvanized steel pipe. Remove end burrs by grinding.
 2. Sheet Metal Pipe Sleeves: Fabricate from G-90 galvanized sheets closed with lock-seam joints. Provide the following minimum gauges for the sizes indicated:
 - a. Sleeve Size 4-inches in Diameter and Smaller: 18 gauge.
 - b. Sleeve Sizes 5-6-inches: 16 gauge.
 - c. Sleeve Sizes 7-inches and Larger: 14 gauge.
 - d. Fire-Rated Safing Material.
 - 1) Rockwool Insulation: Complying with FS-HH-I-558, Form A, Class IV, 6 pounds per cubic foot density with melting point of 1985 degrees F and K value of 0.24 at 75 degrees F.
 - 2) Calcium Silicate Insulation: Noncombustible, complying with FS-HH-I-523, Type II, suitable for 100 degrees F to 1200 degrees F service with K value of 0.40 at 150 degrees F.

2.04 BUILDING ATTACHMENTS

- A. Beam Clamps:
 1. MSS Type 19 and 23, wide throat, with retaining clip.
 2. Universal Side Beam Clamp: MSS Type 20.
- B. Powder-Actuated Drive Pin Fasteners: Powder actuated type, drive pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Anchor Bolts:
 1. Anchor supports to existing masonry, block and tile walls per anchoring system manufacturer's recommendations or as modified by project structural engineer. Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
 2. Anchor Bolts (Cast-In-Place): Steel bolts, ASTM A307. Nuts to conform to ASTM A194. Design values for shear and tension not more than 80 percent of the allowable listed loads.
 3. Anchor (Expansion) Bolts: Carbon steel to ASTM A307; nut to conform to ASTM A194; drilled-in type. Design values for shear and tension not more than 80 percent of the allowable listed loads.

4. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.

2.05 FLASHING

- A. Steel Flashing: 26 gauge galvanized steel.
- B. Safes: 8 mil thick neoprene.
- C. Caps: Steel, 22 gauge minimum, 16 gauge at fire-resistant structures.

2.06 MISCELLANEOUS METAL AND MATERIALS

- A. General:
 1. Provide miscellaneous metal items specified, including materials, fabrication, fastenings and accessories required for finished installation, where indicated on drawings or otherwise not shown on drawings that are necessary for completion of the project. Contractor is responsible for their design.
 2. Fabricate miscellaneous units to size shapes and profiles indicated or, if not indicated, of required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes and plates and steel bars, of welded construction using mitered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
- B. Structural Shapes: Where miscellaneous metal items are needed to be fabricated from structural steel shapes and plates, provide members constructed of steel conforming with requirements of ASTM A36 or approved equivalent.
- C. Steel Pipe: Provide seamless steel pipe conforming to requirements of ASTM A53, Type S, Grade A, or Grade B. Weight and size required as specified.
- D. Fasteners: Provide fasteners of types as required for assembly and installation of fabricated items; surface-applied fasteners are specified elsewhere.
- E. Bolts: Low carbon steel externally and internally threaded fasteners conforming with requirements of ASTM A307; include necessary nuts and plain hardened washers. For structural steel elements supporting mechanical material or equipment from building structural members or connection thereto, use fasteners conforming to ASTM A325.
- F. Miscellaneous Materials: Provide incidental accessory materials, tools, methods, and equipment required for fabrication.
- G. Provide hot dipped galvanized components for items exposed to weather. Cold galvanize field-welded joints and components. Use materials compatible with system being supported (i.e. aluminum for aluminum ductwork, stainless steel for stainless steel ductwork).
- H. Use straps, threshold rods and wire with sizes required by SMACNA to support ductwork.
- I. Grout:
 1. ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 2. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 3. Properties: Nonstaining, noncorrosive, and non gaseous.
 4. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

END OF SECTION

SECTION 23 05 48 - VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation
 - 2. Seismic Restraint Devices
 - 3. Vibration Isolation Equipment Bases
 - 4. Factory Finishes
 - 5. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork
- B. General:
 - 1. Vibration isolation for mechanical ductwork, piping and equipment.
 - 2. Seismic restraint for mechanical ductwork, piping and equipment.
 - 3. Seismic Certification for equipment, hangers and systems
 - 4. Special inspections for systems.
- C. Scope of Work:
 - 1. Vibration isolation and seismic restraint of new equipment and systems within project boundary defined in architectural drawings.
 - 2. Vibration isolation and seismic restraint of new equipment and systems in existing buildings to points of connection with existing systems.
 - 3. Seismic restraint of existing systems and equipment shown on drawings, within project boundary defined in architectural drawings.
 - 4. Provide supplementary structural steel for seismic restraint systems. No hanging from roof deck is permitted on this project, unless specifically allowed by Structural Engineer of Record in writing prior to bid.

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Vibration Isolation:
 - a. Product Data: Provide catalog data indicating size, type, load and deflection of each isolator; and percent of vibration transmitted based on lowest disturbing frequency of equipment.
 - b. Shop Drawings: Showing complete details of construction for steel and concrete bases including:
 - 1) Fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment and cantilever loads.
 - 2) Equipment mounting holes.
 - 3) Dimensions.
 - 4) Size and location of concrete and steel bases and curbs.
 - 5) Isolation selected for each support point.
 - 6) Details of mounting brackets for isolator.
 - 7) Weight distribution for each isolator.
 - 8) Details of seismic snubbers.
 - 9) Code number assigned to each isolator.

- c. Design calculations: Provide calculations for selecting vibration isolators and for designing vibration isolation bases.
2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
3. Seismic Restraint:
 - a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop drawings to be stamped by a professional Structural Engineer licensed in State of California.
 - b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details and indicate quantity, diameter and depth of penetration of anchors. Calculations certified by professional Structural Engineer licensed in State of California.
4. Seismic Restraint Details: Detail fabrication and attachment of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter and depth of penetration of anchors.
5. Submittals for Interlocking Snubbers: Include load deflection curves up to 1/2-inch deflection in x, y and z planes.
6. Welding certificates.
7. Equipment Certification: Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 1. Vibration Isolation:
 - a. Except for packaged equipment with integral isolators, single manufacturer selects and furnishes isolation required.
 - b. Deflections indicated on drawings are minimum actual static deflections for specific equipment supported.
 - c. Isolator Stability:
 - 1) Size springs of sufficient diameter to maintain stability of equipment being supported. Spring diameters not less than 0.8 of compressed height at rated load.
 - 2) Springs have minimum additional travel to solid equal to 50 percent of rated deflection.
 - 3) Springs support 200 percent of rated load, fully compressed, without deformation or failure.
 - d. Maximum Allowable Vibration Levels: Peak vibration velocities not exceed 0.08 in/sec. Correct equipment operating at vibration velocities that exceed this criteria.
 2. Seismic Restraint:
 - a. Code and Standard Requirements:
 - 1) Seismic restraint of equipment, piping and ductwork to be in accordance with latest enacted version of CBC Chapter 16.
 - b. Confirm Seismic Control requirements in Division 01, General Requirements and Structural documents.
 - c. Certification: See Seismic Design Table or schedules on Drawings for equipment, systems and seismic-restraint devices designated to have seismic certification/qualification. Horizontal and vertical load testing and analysis performed according to ASCE 7-10. Anchorage systems to bear anchorage preapproval number from an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing or calculations, if

preapproved ratings are not available. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be sealed by qualified licensed professional engineer in State of California. Testing and calculations must include both shear and tensile loads and one test or analysis at 45 degrees to weakest mode.

- d. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure be designed to resist total design seismic force prescribed in local building code:
 - 1) Floor- or roof-mounted equipment weighing 400 pounds or greater.
 - 2) Suspended, wall-mounted or vibration isolated equipment weighing 20 pounds or greater.
 - 3) In-line duct devices connected to ductwork weighing 75 pounds or greater.
 - 4) Housekeeping slabs: provide reinforcement and anchorage to building structure.
 - e. Where required, seismic sway bracing of suspended duct and piping meet following:
 - 1) Pipe and duct runs requiring seismic bracing have minimum of two traverse braces and one longitudinal brace. Longitudinal (or traverse) brace at 90 degree change in direction may act as traverse (or longitudinal) brace if located within 2-feet of change in direction.
 - 2) Seismic bracing may not pass through seismic separation joint. Pipe or duct runs that pass through seismic separation joint must be restrained within 5-feet of both sides of separation.
 - 3) Seismic brace assembly spacing not to exceed 40-feet transverse and 80-feet longitudinal.
 - f. Seismic restraints may be omitted from suspended piping and duct if following conditions are satisfied:
 - 1) For piping or ducts supported by rod hangers 12-inches or less in length from top of duct to bottom of structural support. Top connections to structure have swivel joints, eye bolts, or vibration isolation hangers for entire length of system run.
 - 2) Lateral motion of system will not cause damaging impact with surrounding systems or cause loss of system vertical support.
 - 3) System must be welded steel pipe, brazed copper pipe, sheet metal duct or similar ductile material with ductile connections.
- C. Seismic restraints, including anchors to building structure, be designed by registered professional Structural Engineer licensed in State of California. Design includes:
- 1. Number, size, capacity and location of anchors for floor- or roof-mounted equipment. For curb-mounted equipment, provide design of attachment of both unit to curb and curb to structure.
 - 2. Number, size, capacity and location of seismic restraint devices and anchors for vibration-isolation and suspended equipment. Provide calculations and test data verifying horizontal and vertical ratings of seismic restraint devices.
 - 3. Number, size, capacity and location of braces and anchors for suspended piping and ductwork on as-built plan drawings.
 - 4. Maximum seismic loads to be indicated on drawings at each brace location. Drawings bear stamp and signature of registered professional Structural Engineer who designed layout of braces.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 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.
- B. Seismic Snubber Units: Furnish replacement neoprene inserts for snubbers.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Vibration Isolation:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. M.W. Saussé - Vibrex
 - 4. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
- B. Seismic Restraint Devices:
 - 1. B-Line Systems, Inc.
 - 2. Kinetics Noise Control, Inc.
 - 3. Mason Industries, Inc.
 - 4. M.W. Saussé - Vibrex
 - 5. Cooper B-Line Tolco
 - 6. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 - 7. Hilti, Inc.
- C. Vibration Isolation Equipment Bases:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. M.W. Saussé - Vibrex
 - 4. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
- D. Factory Finishes:
 - 1. Kynar 500 Fluoropolymer Coating
- E. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:
 - 1. Kinetics Noise Control, Inc.
 - 2. Mason Industries, Inc.
 - 3. Hilti, Inc.
 - 4. Cooper B-Line, Inc.
 - 5. Unistrut
 - 6. ISAT, Inc.
 - 7. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.

2.02 VIBRATION ISOLATION

- A. Type 1 - Neoprene Pad: Natural rubber waffle pads, arranged in single or multiple layers, 3/4-inch thick per layer with pattern repeating on 1/2-inch centers; 50 durometer hardness; maximum loading 60 PSI. Minimum 1/4-inch thick steel load distribution plate and 1/16-inch shim plates between layers, factory cut to sizes matching requirements of supported equipment. Molded bridge with neoprene anchor bolt bushing and flat washer face to prevent metal to metal contact. Number of layers required for equipment scheduled. Mason Type: Super WMH.
- B. Type 2 - Neoprene Mount: Double-deflection type, with ductile-iron housing containing two separate and opposing, oil-resistant natural rubber or bridge bearing neoprene elements, factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Neoprene elements to prevent metal to metal contact during normal operation. Minimum static deflection of 0.20-inches. Mason Type: BR.
- C. Type 3 - Spring: Freestanding, laterally stable, open-spring isolators.
 - 1. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 - 2. Minimum Additional Travel: 50 percent of required deflection at rated load.
 - 3. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch- thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside. Baseplates limit floor load to 100 PSIG (690 kPa).
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
 7. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 8. Mason Type: SLFH or SLF.
- D. Type 4a - Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
1. Housing: Steel with resilient vertical-limit stops (out of contact during normal operation) to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch thick, natural rubber or bridge bearing neoprene isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation. Restraining bolts have large rubber grommets to provide cushioning in vertical and horizontal directions. A minimum clearance of 3/8-inch maintained around restraining bolts so as not to interfere with spring action.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 7. Mason Type: SLR.
- E. Type 4b - Housed Spring Mounts: Housed spring isolator with integral seismic snubbers.
1. Housing: Ductile-iron or steel housing to provide all-directional seismic restraint with neoprene acoustical cup, spring inspection ports and rebound adjustment ports.
 2. Base: Factory drilled for bolting to structure.
 3. Snubbers: Vertically adjustable to allow a maximum of 1/4-inch travel before contacting a resilient collar.
 4. Brackets: Manufacturer's standard bracket, utilize height saving brackets to accommodate height restrictions.
 5. Mason Type: SSLFH.
- F. Type 5a - Restrained Elastomeric Hangers: Double-deflection type, with molded, oil-resistant natural rubber or bridge bearing neoprene isolator elements bonded to steel housings with threaded connections for hanger rods. Color-code or otherwise identify to indicate capacity range. Seismic rebound steel and bonded LDS rubber washer to limit upward seismic movement. Mason Type: RWHD.
- G. Type 5b- Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

6. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.
 7. Mason Type: 30N.
- H. Type 5c - Spring Hangers with Vertical-Limit Stop: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.
1. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 15 degrees of angular hanger-rod misalignment from vertical without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.
 8. Mason Type: RW30.
- I. Type 6 - Horizontal Thrust Restraints: Combination coil spring and elastomeric insert with spring and insert in compression and with a load stop. Include rod and angle-iron brackets for attaching to equipment.
1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of compressed height of spring at rated load.
 3. Minimum Additional Travel: 50 percent of required deflection at rated load.
 4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
 7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.
 8. Mason Type: WBI or WBD.
- J. Type 7 - Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on isolation material of 500 PSIG (3.45 MPa) and for equal resistance in all directions. Mason Type: ADA.
- K. Type 8 - Resilient Pipe Vertical Sliding Guide: Telescopic arrangement of 2 steel tubes separated by a minimum of 1/2-inch thick, 60-durometer neoprene. Factory set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction. Shear pin be removable and reinsertable to allow for selection of pipe movement. Guides be capable of motion to meet location requirements. Mason Type: VSG. Provide pipe expansion hangers to control load shifts as the riser expands or contracts, Mason HES.
- L. Type FC-1, Flexible duct connectors. See Specification Section 23 33 00 Air Duct Accessories.
- M. Type FC-2A, Flexible Pipe Connector, Steel:
1. 321 stainless steel, close pitch, annular corrugated hose.
 2. Exterior Sleeve: 304 stainless steel, braided.
 3. Pressure Rating: 125 PSI at 70 degrees F for 12-inch and smaller pipe.
 4. Joint: ANSI Class 150 carbon steel flanges.
 5. Size: Use pipe sized units.
 6. Minimum Allowable Offset: 3/4-inch on each side of installed center line.

7. Basis of Design: Metraflex Model MLP.
- N. Type FC-2B, Flexible Pipe Connector, Copper:
1. Inner Hose: Bronze, close pitch, annular corrugated hose.
 2. Exterior Sleeve: Braided bronze (for piping over 2-inches, to be 3 pound braided stainless steel).
 3. Minimum Allowable Pressure Rating: 125 PSI at 70 degrees F.
 4. Joint: Sweat ends.
 5. Size: Use pipe sized units.
 6. Minimum Allowable Offset: 3/8-inch on each side of installed center line.
 7. Basis of Design: Metraflex Model BBS.
- O. Type FC-2C, Flexible Pipe Connector, Gas:
1. Inner Hose: 304 stainless steel.
 2. Exterior Sleeve: Braided, 304 stainless steel.
 3. Minimum Allowable Pressure Rating: 150 PSI at 70 degrees F up to 4-inch pipe.
 4. Joint: Threaded carbon steel.
 5. Minimum Allowable Offset: 3/4-inch on each side of installed center line.
 6. Basis of Design: Metraflex GASCT.
- P. Type FC-3, Flexible Compensator, Double Sphere:
1. Body: Molded twin spherical type. Neoprene with internal cord or wire.
 2. Minimum Pressure Rating, Sizes 2-inch to 12-inch: 225 PSI at 170 degrees F.
 3. Minimum Pressure Rating, Sizes 14-inch to 20-inch: 125 PSI at 170 degrees F.
 4. Minimum Allowable Compression: 1-1/2 inches.
 5. Minimum Allowable Elongation: 1-1/8 inches.
 6. Minimum Allowable Offset: 1-1/8 inches.
 7. Minimum Allowable Angular Movement: 20 degrees.
 8. Joint: Steel flanges.
 9. Accessories: Galvanized aircraft-type cable or control rods to prevent over extension.
 10. Basis of Design: Metraflex Doublesphere.

2.03 SEISMIC RESTRAINT DEVICES

- A. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5, with a flat washer face.
- B. Seismic Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
 1. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.
 2. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.
- C. Restraining Cables: Galvanized steel aircraft cables with end connections made of steel assemblies that swivel to final installation angle and utilize two clamping bolts for cable engagement. Mason Type: SCB.
- D. Anchor Bolts: Seismic-rated, drill-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488/E 488M.

2.04 VIBRATION ISOLATION EQUIPMENT BASES

- A. Steel Base (Type B-1): Factory-fabricated, welded, structural-steel bases and rails. Mason Type: WFSL.
 1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates and bars complying with ASTM A 36/A 36M. Bases have shape to accommodate supported equipment.

3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Type 3 spring mounts. Mason Type: SLF.
 5. Seismic Snubbers: Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
- B. Inertia Base (Type B-2): Factory-fabricated, welded structural -steel bases and rails ready for field applied, cast-in-place concrete. Mason Type: KSL, BMK.
1. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates and bars complying with ASTM A 36/A 36M. Bases have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
 5. Type 3, spring mounts. Mason Type: SLF.
 6. Seismic Snubbers:
 - a. Factory fabricated using welded structural-steel shapes and plates, anchor bolts and replaceable resilient isolation washers and bushings. Snubber load rating to match equipment size. Mason Type: Z-1011 or Z-1225.
 - b. Anchor bolts for attaching to concrete be seismic-rated, drill-in and stud-wedge or female-wedge type.
 - c. Resilient Isolation Washers and Bushings: 1-piece, molded, bridge-bearing neoprene complying with AASHTO M 251 and having a durometer of 50, plus or minus 5.

2.05 FACTORY FINISHES

- A. Provide manufacturer's standard prime-coat finish ready for field painting. Units mounted outdoors exposed to weather: Epoxy powder coated, with 1000 hour salt spray rating per ASTM B-117. For high levels of corrosion protection utilize:
1. Conform to AAMA 605.2.
 2. Apply coating following cleaning and pretreatment.
 3. Cleaning: AA-C12C42R1X.
 4. Dry system before final finish application.
 5. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.
- B. Finish:
1. Manufacturer's standard paint applied to factory-assembled and factory-tested equipment before shipping.
 2. Powder coating on springs and housings.
 3. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
 4. Baked enamel for metal components on isolators for interior use.
 5. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.06 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING AND DUCTWORK

- A. General Requirements for Restraint Components: Rated strengths, features and applications to be as defined in reports by agency acceptable to authorities having jurisdiction.
- B. Structural Safety Factor: Allowable strength in tension, shear and pullout force of components be at least four times maximum seismic forces to which they will be subjected.

- C. Anchor bolts for attaching to concrete to be seismic-rated, drill-in and stud-wedge or female-wedge type.
- D. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
- E. Maximum 1/4-inch air gap and minimum 1/4-inch thick resilient cushion.

END OF SECTION

SECTION 23 05 53 - IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Tags
 - 3. Plastic Pipe Markers
 - 4. Ceiling Tags

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Schedules:
 - a. Submit valve schedule for each piping system, in tabular format using Microsoft Word or Excel software. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shutoff and similar special uses by special "flags" in margin of schedule. In addition to mounted copies, furnish extra copies for maintenance manuals.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer's Qualifications: Firms regularly engaged in manufacture of identification devices of types and sizes required.
 - 2. Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices unless otherwise indicated.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC Sections. Where more than a single type is specified for application, provide single selection for each product category.
- B. Plastic Nameplates:
 - 1. Brady Corporation
 - 2. Brimar
 - 3. Champion America
 - 4. Craftmark
 - 5. Seton
 - 6. Or approved equivalent.

- C. Tags:
 1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
 6. Or approved equivalent.
- D. Plastic Pipe Markers:
 1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
 6. Or approved equivalent.
- E. Ceiling Tags:
 1. Brady Corporation
 2. Brimar
 3. Champion America
 4. Craftmark
 5. Seton
 6. Or approved equivalent.

2.02 PLASTIC NAMEPLATES

- A. Description: Engraving stock melamine plastic laminate in the size and thicknesses indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black with white core (letter color), punched for mechanical fastening except where adhesive mounting is necessary because of substrate. Provide 1/8-inch thick material.
 1. Letter Color: White.
 2. Letter Height: 1/2-inch.
 3. Background Color: Black.
 4. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.
 5. Access Panel Markers: Manufacturer's standard 1/16-inch thick engraved plastic laminate access panel markers, with abbreviations and numbers corresponding to concealed valve or devices/equipment. Include center hole to allow attachment.

2.03 TAGS

- A. Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 2-inch diameter.
- B. Metal Tags: Polished Brass with stamped letters; tag size minimum 2-inch diameter with smooth edges.
- C. Valve designations to be coordinated with existing valve identifications to ensure no repetitive designations are utilized.
- D. Chart/Schedules: Valve Schedule Frames. For each page of a valve schedule, provide glazed display frame with removable mounting as appropriate for wall construction upon which frame is to be mounted. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.
- E. Valve Tag Fasteners: Solid brass chain (wire link or beaded type), or solid brass S-hooks.
- F. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.
 1. Size: Approximately 4 by 7-inches.
 2. Fasteners: Brass grommet and wire.

3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.
4. Color: Yellow background with black lettering.

2.04 PLASTIC PIPE MARKERS

- A. Color: Conform to ASME A13.1 and ANSI Z535.1.
- B. Plastic Pipe Markers (for external diameters of 6-inches and larger including insulation): Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
- C. Plastic Tape Pipe Markers (for external diameters less than 6-inches including insulation): Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.
- D. Lettering:
 1. 3/4-inch to 1-1/4-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 1/2-inch high letters.
 2. 1-1/2-inch to 2-inch Outside Diameter of Insulation or Pipe: 8-inch long color field, 3/4-inch high letters.
 3. 2-1/2-inch to 6-inch Outside Diameter of Insulation or Pipe: 12-inch long color field, 1-1/4-inch high letters.
 4. 8-inch to 10-inch Outside Diameter of Insulation or Pipe: 24-inch long color field, 2-1/2-inch high letters.
 5. Over 10-inch Outside Diameter of Insulation or Pipe: 32-inch long color field, 3-1/2-inch high letters.

2.05 CEILING TAGS

- A. Description: Steel with 3/4-inch diameter color coded head.
- B. Color code as follows:
 1. Yellow - HVAC equipment.
 2. Red - Fire dampers/smoke dampers.
 3. Blue - Heating/cooling valves.
 4. Ceiling tile labels, machine generated, adhesive backed tape labels with black letters, clear tape.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. General Requirements and Procedures
 - 2. Pre-Construction Balance (Existing Systems)
 - 3. Ductwork Pressure Testing
 - 4. Fundamental Air Systems Balancing Procedures
 - 5. Temperature Control Verification
 - 6. Constant Volume Air Systems Balancing Procedures
 - 7. Pre-Balance Reporting
 - 8. Final Reports:
 - a. Report Requirements
 - b. General Report Data
 - c. System Diagrams
 - d. Air Handling Units
 - e. Hydronic Coils
 - f. Fans
 - g. Duct Traverses
 - h. Diffusers/Registers/Grilles
 - i. Instrument Calibration
 - 9. Additional Tests

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Quality-Assurance Submittals: Submit two copies of evidence that the Testing, Adjusting, and Balancing (TAB) Agent and this Project's TAB team members meet the qualifications specified in the "Quality Assurance" Article below.
 - 2. Pre-Construction Phase Report:
 - a. Provide a pre-construction phase TAB Plan at least two weeks prior to the commencement of TAB work. This report is to include:
 - 1) A complete set of report forms intended for use on the project, with data filled in except for the field readings. Forms to be Project-specific.
 - 2) Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - 3) Identification of the type, manufacturer, and model of the actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
 - 4) A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.
 - 3. Contract Documents Examination Report: Within 45 days from the Contractor's Notice to Proceed, submit two copies of the Contract Documents review report as specified in Part 3 of this Section.

4. Strategies and Procedures Plan: Submit two copies of the TAB strategies and step-by-step procedures as specified in Part 3 below. Include a complete set of report forms intended for use on this Project.
5. Specify reports required because of editing procedures in Part 3 of this Section.
6. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the TAB Agent.
7. Sample Report Forms: Submit two sets of sample TAB report forms.
8. Test Instrument Calibration: Submit proof of calibration within the last 6 months.
9. Final Report.
10. Provide additional submittals to commissioning authority as dictated in commissioning specifications.

1.05 QUALITY ASSURANCE

- A. Quality Assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 1. Balance Firm Qualifications:
 - a. General:
 - 1) Procure services of independent TAB agency to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. Minimum experience: 5 years.
 - 2) Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
 - b. Testing and Balancing firm is certified by NEBB or AABC and has a NEBB Certified Professional (CP) or a AABC Test and Balancer Engineer (TBE) on staff.
 - c. Industry Standards: Testing and Balancing will conform to NEBB or AABC, and American National Standards Institute (ANSI) as follows:
 - 1) NEBB: Comply with Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
 - 2) AABC: Comply with National Standards for Total System Balance.
 - 3) ANSI:
 - (a) S1.4 Specifications for sound level meters.
 - (b) S1.11 Specifications for Octave-Band and Fractional-Octave-Band analog and digital filters.
 - (c) ANSI S1.13 Methods for the Measurement of Sound Pressure Levels.
 - d. Test Observation: If requested, conduct tests in the presence of the Commissioning Authority, AHJ, Architect or the Architect's representative.
 2. Noise Criteria:
 - a. Noise levels in all 8 octave bands due to equipment and duct systems are not to exceed the following NC levels:

TYPE OF ROOM	NC LEVEL
Bathrooms and Toilet Rooms	35-40
Conference Room	30-35
Corridors (Public)	35-40
Offices, Small Private (2 or fewer occupants)	30-35
All Others	35-40

- b. An allowance, not to exceed 5db, may be added to the measured value to compensate for the variation of the room attenuating effect between room test condition prior to occupancy and design condition after occupancy which may include the addition of sound absorbing material, such as furniture. This allowance may not

- be taken after occupancy. The room attenuating effect is defined as the difference between sound power level emitted to room and sound pressure level in room.
- c. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
 3. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
 4. Owner Witness: Perform tests in the presence of the Commissioning Authority, Architect, Architect's Representative, or Owner's representative.
 5. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
 6. Simultaneous Testing: Test observations by the AHJ, the Owner's Authorized Representative and the engineer's representative need not occur simultaneously.
 7. Do not perform TAB work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
 8. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
 9. TAB Conference: Meet with the Commissioning Authority, Owner's and the Architect's representatives on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls Installer, and other support personnel. Provide 7 days advance notice of scheduled meeting time and location.
 - a. Agenda Items: Include at least the following:
 - 1) Submittal distribution requirements.
 - 2) Contract Documents examination report.
 - 3) TAB plan.
 - 4) Work schedule and Project site access requirements.
 - 5) Coordination and cooperation of trades and subcontractors.
 - 6) Coordination of documentation and communication flow.
 10. Certification of TAB Reports: This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - b. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
 11. TAB Reports: Use standard forms from AABC or NEBB.
 12. Instrumentation Type, Quantity, and Accuracy: As described in AABC or NEBB.
 13. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 1. TAB Agency provides warranty for a period of 90 days following submission of completed report, during which time, Owner may request a recheck of up to 10 percent of total number of terminals, or resetting of any outlet, coil, or device listed in the final TAB report.
 2. Guarantee: Meet the requirements of the following programs:
 - a. Provide a guarantee on AABC or NEBB forms stating that the agency will assist in completing the requirements of the Contract Documents if the TAB Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1) The certified Agent has tested, adjusted, and balanced systems according to the Contract Documents.
 - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.07 DEFINITIONS

- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to design quantities.
- C. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a persons skin than is normally dissipated.
- D. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- E. Report Forms: Test data sheets for recording test data in logical order.
- F. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.
- G. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- H. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- I. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- J. TAB: Testing, Adjusting, and Balancing.
- K. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- L. Test: A procedure to determine quantitative performance of a system or equipment.
- M. Testing, Adjusting, and Balancing (TAB) Agent: The entity responsible for performing and reporting the TAB procedures.
- N. AABC: Associated Air Balance Council.
- O. NEBB: National Environmental Balancing Bureau.
- P. AMCA: Air Movement and Control Association.
- Q. CTI: Cooling Tower Institute.
- R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.08 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Witness leakage and pressure tests carried out by Section 23 31 00.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 - PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 GENERAL REQUIREMENTS AND PROCEDURES

- A. Project Conditions:
 - 1. Non-Owner Occupancy: Complete balancing of building systems prior to Substantial Completion and owner occupancy.
- B. General Requirements:

1. Where HVAC systems and/or components interface with life safety systems, including fire and smoke detection, alarm, and controls, coordinate scheduling and testing and inspection procedures with authorities having jurisdiction.
 2. Perform TAB work with doors, closed windows, and ceilings installed etc., to obtain simulated or project operating conditions. Do not proceed until systems scheduled for TAB are clean and free from debris, dirt and discarded building materials.
 3. Where Owner occupies building during the testing period, cooperate with Owner to minimize conflicts with Owner's operations.
- C. Examination:
1. Examine Contract Documents to become familiar with project requirements and existing building record documents (if available) to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 - a. Contract Documents are defined in the General and Supplementary Conditions of the Contract.
 - b. Verify that balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 2. Examine approved submittal data of HVAC systems and equipment.
 3. Examine project record documents described in Division 01, General Requirements.
 4. Examine Architect's and Engineer's design data, including Basis of Design, 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.
 5. Examine equipment performance data, including fan and pump curves. 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. Calculate system effect factors to reduce the performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.
 6. Coordinate requirements in system and equipment with this Section.
 7. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Specification Sections have been performed.
 8. Examine system and equipment test reports.
 9. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 10. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
 11. Examine equipment for installation and for properly operating safety interlocks and controls.
 12. Report deficiencies discovered before and during performance of TAB procedures.
- D. Preparation:
1. Prepare a TAB plan that includes strategies and step-by-step procedures.
 2. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - a. Permanent electrical power wiring is complete.

- b. Hydronic systems are filled, clean, and free of air.
 - c. Automatic temperature-control systems are operational.
 - d. Equipment and duct access doors are securely closed.
 - e. Balance, smoke, and fire dampers are open.
 - f. Isolating and balancing valves are open and control valves are operational.
 - g. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - h. Windows, doors and other portions of the building envelope can be closed so design conditions for system operations can be met.
- 3. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - a. Attendance is required by installers whose work will be tested, adjusted, or balanced.
 - 4. Provide instruments required for TAB operations. Make instruments available to Architect to facilitate spot checks during testing.
- E. General TAB Procedures:
- 1. Perform TAB procedures on each system according to the procedures contained in AABC or NEBB and this Section.
 - 2. Coordinate location of test probes prior to start of TAB procedures and make test probes available for Owner's tests after start of occupancy. Where required, cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to the insulation Specifications for this Project.
 - 3. Mark equipment settings with paint or other suitable, permanent identification material, including damper-control positions, valve indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- F. Adjustment Tolerances:
- 1. Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
 - 2. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design. Adjust outlets and inlets in space to within plus or minus 10 percent of design.
 - 3. Hydronic Systems: Adjust to within plus or minus 10 percent of design at coils and plus or minus 5 percent at system pumps and equipment.
 - 4. Adjust supply, return, and exhaust air quantities to maintain pressurization in spaces indicated on Drawings. Note and document room-to-room pressurization and maintain these relationships. Adjust pressure controlled spaces to within plus or minus 0.01 in WC.
- G. Recording and Adjusting:
- 1. Field Logs: Maintain written logs including:
 - a. Running log of events and issues.
 - b. Discrepancies, deficient or uncompleted work by others.
 - c. Contract interpretation requests.
 - d. Lists of completed tests.
 - 2. Ensure recorded data represents actual measured or observed conditions.
 - 3. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 - 4. Mark on drawings locations where traverse and other critical measurements were taken and cross reference location in final report.
 - 5. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 - 6. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
 - 7. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner's Authorized Representative, or Commissioning Agent.

3.02 PRE-CONSTRUCTION BALANCE (EXISTING SYSTEMS)

- A. Pre-Construction Balance - Hydronic Systems
 - 1. Prior to start of construction or demolition; read and record flow of hydronic systems to establish "as-found" conditions.
 - 2. Read and record head loss and flow at existing coils, heat exchangers, air control devices, and pumps.
 - 3. Read and record amp draw and motor data from each existing pump.
- B. Report data and observations to Architect.

3.03 DUCTWORK PRESSURE TESTING

- A. Provide air pressure testing of concealed ductwork systems (testing is not required for ductwork exposed to air conditioned space). Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved.
- B. Test ductwork prior to connection to fan equipment. Repair leaks and retest until stipulated results are achieved. Pressure testing to meet the following leakage classifications below as a minimum (2012 SMACNA HVAC Air Duct Leakage Manual, Table 4-1):
 - 1. Leakage class to be as defined below as a minimum.
 - a. Minimum Duct Leakage Classification

Duct Type	Leakage Class
Metal (Flexible excluded)	
Round and flat oval	3
Rectangular	6

- 2. Testing machine: Meet requirements of SMACNA standards. Pacific Air Products "Port-O-Lab", Rolok, or United Sheet Metal
- 3. Test supply systems prior to connecting terminal units.
- 4. Perform tests in presence of Owner's Authorized Representative. Give 48 hours advance notice before commencement of each test.
- 5. Test ductwork systems in sections as large as possible and record test results accordingly.
- 6. Coordinate testing with ceiling installation.
 - a. Provide sheet-metal plates and install between each duct test section (applies to main-to-main fittings, branch-to-branch fittings and main-to-branch fittings). At each plate location, fabricate joint with Ductmate. Insert 14 gauge sheet metal between Ductmate using a neoprene gasket on both sides of metal plate.
 - b. Leave plates in place until isolated section has been tested and approved by Owner's Authorized Representative.
 - c. Once sections have passed test, remove plates and reattach Ductmate joints. After fan unit is running, test joint for leakage by using a mixture of soap and water. If any noise or bubbling occurs, reseal joint. Owner's Authorized Representative to witness this procedure.
- 7. Test duct at 1.5 times the design air pressure. Seal any audible leaks.

3.04 FUNDAMENTAL AIR SYSTEMS BALANCING PROCEDURES

- A. Examine air-handling equipment to ensure clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- B. Examine terminal units, such as variable-air-volume boxes and mixing boxes, to verify that they are accessible and their controls are connected and functioning.
- C. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

- D. Prepare test reports for both fans and inlets and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Cross check the summation of required outlet volumes with required fan volumes.
- E. Prepare schematic diagrams of systems' "as-built" duct layouts.
- F. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- G. Check the airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- H. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- I. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- J. Check dampers for proper position to achieve desired airflow path.
- K. Check for airflow blockages.
- L. Check that condensate drains are installed, trapped and primed and routed to drain.
- M. Check for readily observable leaks in air-handling unit components and ductwork.
- N. Use sheaves and pulleys to adjust the speed of belt drive fans to achieve design flow with motors running at 60 Hertz unless noted otherwise.

3.05 TEMPERATURE CONTROL VERIFICATION

- A. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices operate by the intended controller.
 - 2. Dampers and valves are in the position indicated by the controller.
 - 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
 - 4. Automatic modulating and shutoff valves, including 2-way valves and 3-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, equipment, drafts, and cold walls.
 - 6. Sensors are located to sense only the intended conditions.
 - 7. Sequence of operation for control modes is according to the Contract Documents.
 - 8. Controller set points are set at design values. Observe and record system reactions to changes in conditions. Record default set points if different from design values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to design values.
- B. Verify that controllers are calibrated and commissioned.
- C. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- D. Record controller settings and note variances between set points and actual measurements.
- E. Verify operation of limiting controllers (i.e., high- and low-temperature controllers).
- F. Verify free travel and proper operation of control devices such as damper and valve operators.
- G. Verify sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water-flow measurements. Note the speed of response to input changes.
- H. Confirm interaction of electrically operated switch transducers.
- I. Confirm interaction of interlock and lockout systems.
- J. Verify main control supply-air pressure and observe compressor and dryer operations.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.06 CONSTANT VOLUME AIR SYSTEMS BALANCING PROCEDURES

- A. Adjust fans to deliver total design airflows within the maximum allowable rpm listed by the fan manufacturer. Adjust fans to deliver design airflow at the lowest possible speed.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.
 - 2. Measure static pressure across each air-handling unit component under final balanced condition.
 - 3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Recommend corrective action to align design and actual conditions.
 - 4. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 5. Do not make fan-speed adjustments that result in motor loading greater than full load amps. Do not increase fan speed beyond fan class rating. Modulate dampers and measure fan-motor amperage to ensure no overload will occur. Measure amperage in full cooling, full heating, and economizer modes to determine the maximum required brake horsepower.
 - 6. Adjust volume dampers for main duct, submain ducts, and major branch ducts to design airflows within specified tolerances.
 - 7. Calibrate airflow measuring stations.

3.07 PRE-BALANCE REPORTING

- A. Pre-Construction Phase Report:
 - 1. Provide a pre-construction phase TAB Plan at least 2 weeks prior to the commencement of TAB work. This report is to include:
 - a. A complete set of report forms intended for use on the project, with all data filled in except for the field readings. Forms to be project specific.
 - b. Marked up shop drawings identifying all HVAC equipment to be balanced, and associated outlets and terminal devices.
 - c. Identification of the type, manufacturer, and model of actual instruments to be used, and clear indication of which instrument will be used to take each type of reading. Calibration certifications are to be included.
 - d. A narrative of any project specific and/or non-standard TAB procedures to be used, and the equipment or systems they apply to.
- B. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article above, 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.
- C. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced.

3.08 FINAL REPORTS

- A. Report Requirements:
 - 1. General:

- a. Computer generated in PDF format and tabulated, divided, and bookmarked into sections by tested and balanced systems.
 - b. Include a certification sheet in front of binder signed and sealed by the certified TAB engineer.
 - 1) Include a list of the instruments used for procedures, along with proof of calibration.
 - c. Final Report Contents: In addition to the 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, but do not include approved Shop Drawings and Product Data.
- B. General Report Data:
- 1. In addition to the form titles and entries, include the following data in the final report, as applicable:
 - a. Title Page
 - b. Name and Address of TAB Agent
 - c. Project Name
 - d. Project Location
 - e. Architect's Name and Address
 - f. Engineer's Name and Address
 - g. Contractor's Name and Address
 - h. Report Date
 - i. Signature of TAB Agent who Certifies the Report
 - j. Summary of Contents, Including the Following:
 - 1) Design versus Final Performance
 - 2) Notable Characteristics of Systems
 - 3) Description of System Operation Sequence if it varies from the Contract Documents
 - k. Nomenclature Sheets for Each Item of Equipment
 - l. Data for Terminal Units, including Manufacturer, Type Size, and Fittings
 - m. Notes to explain why certain final data in the body of reports vary from design values.
 - n. Test Conditions for Fans and Pump Performance Forms, Including the Following:
 - 1) Settings for Outside-, Return-, and Exhaust-air Dampers
 - 2) Conditions of Filters
 - 3) Cooling Coil, Wet- and Dry-bulb Conditions
 - 4) Face and Bypass Damper Settings at Coils
 - 5) Fan Drive Settings, including Settings and Percentage of Maximum Pitch Diameter
 - 6) Inlet Vane Settings for Variable-Air-Volume Systems
 - 7) Settings for Supply-air, Static-pressure Controller
 - 8) Other System Operating Conditions that affect Performance
- C. System Diagrams:
- 1. Include schematic layouts of air and hydronic distribution systems. Present with single-line diagrams and include the following:
 - a. Quantities of Outside, Supply, Return, and Exhaust Airflows
 - b. Water and Steam Flow Rates
 - c. Duct, Outlet, and Inlet Sizes
 - d. Pipe and Valve Sizes and Locations
 - e. Terminal Units
 - f. Balancing Stations

D. Air Handling Units:

1. For air-handling units, split systems, fan coils, pumps, and evaporator units with coils, include the following:
 - a. Unit Data: Include the following:
 - 1) Unit Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Unit Size
 - 5) Manufacturer's Serial Number
 - 6) Unit Arrangement and Class
 - 7) Discharge Arrangement
 - 8) Sheave Make, Size in inches, and Bore
 - 9) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 10) Number of Belts, Make, and Size
 - 11) Number of Filters, Type, and Size
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm (L/s)
 - 2) Total System Static Pressure in Inches wg (Pa)
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg (Pa)
 - 5) Filter Static-pressure Differential in Inches wg (Pa)
 - 6) Preheat Coil Static-pressure Differential in Inches wg (Pa)
 - 7) Cooling Coil Static-pressure Differential in Inches wg (Pa)
 - 8) Heating Coil Static-pressure Differential in Inches wg (Pa)
 - 9) Outside Airflow in cfm (L/s)
 - 10) Return Airflow in cfm (L/s)
 - 11) Outside-air Damper Position
 - 12) Return-air Damper Position
 - 13) Vortex Damper Position

E. Hydronic Coils:

1. For hydronic coils in all equipment with coils, include the following:
 - a. Coil Data: Include the following:
 - 1) System Identification
 - 2) Location and Zone
 - 3) Room or Riser Served
 - 4) Coil Type
 - 5) Number of Rows
 - 6) Fin Spacing in Fins per Inch o.c.
 - 7) Make and Model Number
 - 8) Face Area in SF
 - 9) Tube Size in NPS (DN)
 - 10) Tube and fin Materials
 - 11) Circuiting Arrangement
 - b. Test Data: Include design and actual values for the following:
 - 1) Airflow Rate in cfm

- 2) Average Face Velocity in fpm
- 3) Air Pressure Drop in Inches wg
- 4) Outside-air, Wet- and Dry-bulb Temperatures in Degrees F
- 5) Return-air, Wet- and Dry-bulb Temperatures in Degrees F
- 6) Entering-air, Wet- and Dry-bulb Temperatures in Degrees F
- 7) Leaving-air, Wet- and Dry-bulb Temperatures in Degrees F
- 8) Water Flow Rate in gpm
- 9) Water Pressure Differential in Feet of Head or PSIG
- 10) Entering-water Temperature in Degrees F
- 11) Leaving-water Temperature in Degrees F

F. Fans:

1. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 - a. Fan Data: Include the following:
 - 1) System Identification
 - 2) Location
 - 3) Make and Type
 - 4) Model Number and Size
 - 5) Manufacturer's Serial Number
 - 6) Arrangement and Class
 - 7) Sheave Make, Size in Inches, and Bore
 - 8) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches.
 - b. Motor Data: Include the following:
 - 1) Make and Frame Type and Size
 - 2) Horsepower and rpm
 - 3) Volts, Phase, and Hertz
 - 4) Full-load Amperage and Service Factor
 - 5) Sheave Make, Size in Inches, and Bore
 - 6) Sheave Dimensions, Center-to-center and Amount of Adjustments in Inches
 - 7) Number of Belts, Make, and Size
 - c. Test Data: Include design and actual values for the following:
 - 1) Total Airflow Rate in cfm
 - 2) Total System Static Pressure in Inches wg
 - 3) Fan rpm
 - 4) Discharge Static Pressure in Inches wg
 - 5) Suction Static Pressure in Inches wg

G. Duct Traverses:

1. Include a diagram with a grid representing the duct cross-section and record the following:
 - a. Report Data: Include the following:
 - 1) System and Air-handling Unit Number
 - 2) Location and Zone
 - 3) Duct Static Pressure in Inches wg
 - 4) Duct Size in Inches
 - 5) Duct Area in SF
 - 6) Design Airflow Rate in cfm
 - 7) Design Velocity in fpm
 - 8) Actual Airflow Rate in cfm
 - 9) Actual Average Velocity in fpm

H. Diffusers/Registers/Grilles:

1. For diffusers, registers and grilles, include the following:
 - a. Unit Data: Include the following:
 - 1) System and Air-handling Unit Identification
 - 2) Location and Zone

- 3) Test Apparatus Used
 - 4) Area Served
 - 5) Air-terminal-device Make
 - 6) Air-terminal-device Number from System Diagram
 - 7) Air-terminal-device Type and Model Number
 - 8) Air-terminal-device Size
 - 9) Air-terminal-device Effective Area in SF
- b. Test Data: Include design and actual values for the following:
- 1) Airflow Rate in cfm
 - 2) Air Velocity in fpm
 - 3) Final Airflow Rate in cfm
 - 4) Final Velocity in fpm
 - 5) Space Temperature in Degrees F
- I. Instrument Calibration:
1. For instrument calibration, include the following:
 - a. Report Data: Include the following:
 - 1) Instrument Type and Make
 - 2) Serial Number
 - 3) Application.
 - 4) Dates of Use
 - b. Dates of Calibration.

3.09 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 inspections, testing, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 23 07 00 - HVAC INSULATION

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Type A, Flexible Glass Wool Blanket
 - 2. Type B, Duct Liner
 - 3. Type 1, Glass Wool Pipe Insulation
 - 4. Type 2, Flexible Elastomeric Pipe Insulation
 - 5. Jacketing
 - 6. Accessories
 - 7. Duct Insulation Accessories
 - 8. Duct Insulation Compounds
 - 9. Outdoor Ducting Cover

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Installer qualifications.
 - 2. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any) for each type of product indicated.
 - 3. 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.
 - 4. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.
 - 5. Submit manufacturer's installation instructions.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Formaldehyde Free: Should be third-party certified with UL Environment Validation.
 - 2. Recycled Content: A minimum of 40 percent post-consumer recycled glass content certified and UL validated.
 - 3. Low Emitting Materials: For all thermal and acoustical applications of Glass Mineral Wool Insulation products, provide materials complying with the testing and products requirements of UL GREENGUARD Gold Certification.
 - 4. Installer to have minimum 5 years' experience in the business of installing insulation.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a Flame Spread Index (FSI) of 25 and Smoke Developed Index (SDI) of 50 as tested by current edition of ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with the requirements of current edition of UL "Pipe and Equipment Coverings R5583 400 8.15".
- C. Test duct insulation in accordance with current edition of ASTM E84, UL 723, NFPA 255, NFPA 90A and NFPA 90B.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Type A, Flexible Glass Wool Blanket:
 - 1. Certaineed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
- B. Type B, Duct Liner:
 - 1. Certaineed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
- C. Type 1, Glass Wool Pipe Insulation:
 - 1. Certaineed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
- D. Type 2, Flexible Elastomeric Pipe Insulation:
 - 1. Insulation:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
 - 2. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. K-Flex
 - c. Or approved equivalent.
 - 3. Paint:
 - a. Armacell LLC Armaflex
 - b. K-Flex
 - c. Or approved equivalent.
- E. Jacketing:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- F. Accessories:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- G. Duct Insulation Accessories:
 - 1. Certaineed
 - 2. Johns Manville
 - 3. Owens-Corning
- H. Duct Insulation Compounds:

1. Certaineed
 2. Johns Manville
 3. Owens-Corning
- I. Outdoor Ducting Cover:
1. Certaineed
 2. Johns Manville
 3. Owens-Corning

2.02 TYPE A, FLEXIBLE GLASS WOOL BLANKET

- A. ASTM C553, Type 1, Class B-2; flexible blanket.
- B. 'K' Value: 0.27 BTU*in/(hr*sf°F) at 75 degrees F installed, maximum service temperature: 250 degrees F.
- C. Density: 0.75 pounds per cubic foot.
- D. DBDE-free. UL/E validated to be formaldehyde-free.
- E. Vapor Barrier Jacket: FSK aluminum foil reinforced with glass wool yarn and laminated to fire resistant Kraft, secured with UL listed pressure sensitive tape or outward clinched expanded staples and vapor barrier mastic as needed.

2.03 TYPE B, DUCT LINER

- A. ASTM C1071; flexible blanket.
- B. 'K' Value: ASTM C518, 0.25 BTU*in/(hr*sf°F) at 75 degrees F, maximum service temperature: 250 degrees F.
- C. Noise Reduction Coefficient: 0.65 or higher based on ASTM C 423 "Type A mounting."
- D. Maximum Velocity on Mat or Coated Air Side: 5,000 FPM.
- E. Adhesive: UL listed waterproof type.
- F. Fasteners: Duct liner galvanized steel pins, welded or mechanically fastened.
- G. Erosion-Resistant Surfaces: UL 181.
- H. ASTM G21 and ASTM G22 Microbial Growth Resistance.
- I. UL GREENGUARD Certified does not support the growth of mold, fungi, or bacteria per ASTM C 1338 and meets UL Environment GREENGUARD Microbial Resistance Listing per UL 2824-"GREENGUARD Certification Program Method for Measuring Microbial Resistance". DBDE-free. UL/E validated to be formaldehyde-free.

2.04 TYPE 1, GLASS WOOL PIPE INSULATION

- A. Glass Wool: ASTM C547 Type I and IV; rigid molded, noncombustible.
 1. Thermal Conductivity Value: As indicated in the insulation tables below.
 2. Maximum Service Temperature: 850 degrees F to 1000 degrees F.
- B. Vapor Retarder Jacket: White Kraft paper reinforced with glass wool and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips or vapor barrier mastic.

2.05 TYPE 2, FLEXIBLE ELASTOMERIC PIPE INSULATION

- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 1. Thermal Conductivity Value: As indicated in the insulation tables below.
 2. Maximum Service Temperature of 220 degrees F.
 3. Maximum Flame Spread: 25.
 4. Maximum Smoke Developed: 50 (1-inch thick and below).
 5. Connection: Waterproof vapor retarder adhesive as needed.
 6. UV Protection: UV outdoor protective coating per manufacturer's requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam.

- C. Paint: Nonhardening high elasticity type, specifically manufactured as protective covering of flexible elastomeric foam insulation for prevention of degradation due to exposure to sunlight and weather.

2.06 JACKETING

- A. Canvas Jacket: UL listed fabric, 6 ounce/sq.yd., plain weave cotton treated with dilute fire retardant lagging adhesive.
- B. PVC preformed molded insulation covers. Zeston or approved equivalent.
- C. Aluminum Jacket: 0.016-inch-thick sheet, (smooth/embossed) finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory attached protective liner.
- D. Stainless Steel Jacket: Type 304 stainless steel, 0.010-inch, smooth finish.

2.07 ACCESSORIES

- A. Equipment Insulation Jacketing: Presized glass cloth, not less than 7.8 ounces/sq.yd., except as otherwise indicated. Coat with gypsum based cement.
- B. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- C. General: Provide staples, bands, wire, wire netting, tape corner angles, anchors, stud pins and metal covers as recommended by insulation manufacturer for applications indicated. Accessories, i.e., adhesives, mastics, cements and tape to have the same flame and smoke component ratings as the insulation materials with which they are used. Shipping cartons to bear a label indicating that flame and smoke ratings do not exceed those listed above. Provide permanent treatment of jackets or facings to impart flame and smoke safety. Provide nonwater soluble treatments. Provide UV protection recommended by manufacturer for outdoor installation.

2.08 DUCT INSULATION ACCESSORIES

- A. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.09 DUCT INSULATION COMPOUNDS

- A. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated.

2.10 OUTDOOR DUCTING COVER

- A. Aluminum Jacket: 0.016-inch-thick sheet, smooth/embossed finish, with longitudinal slip joints and 2-inch laps.
- B. Nonwater vapor retarder, nonburning, weatherproof coating for use over insulation where "breathing" is required.
- C. UV resistant polyvinyl chloride covering with joints secured and sealed.

END OF SECTION

SECTION 23 09 00 - INSTRUMENTATION AND CONTROL PERFORMANCE SPECIFICATIONS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Communications
 - 2. Operator Interface
 - 3. Controller Software
 - 4. Web Based Access
 - 5. BAS Graphics
 - 6. Building Controllers
 - 7. Application Specific Controllers
 - 8. Application Specific Controller - Terminal Unit Controllers
 - 9. Input/Output Interface
 - 10. Power Supplies and Line Filtering
 - 11. Control Panels
 - 12. Auxiliary Control Devices
 - 13. Wiring and Raceways
 - 14. Smoke Detection for Projects with a Building Fire Alarm System
- B. This is a performance specification and Contractor is responsible for design tasks and engineering.

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Current edition of ANSI/ASHRAE Standard 135 and addendum, BACnet.
 - 2. Current edition of UL 916 Underwriters Laboratories Standard for Energy Management Equipment, Canada and the US.
 - 3. Current edition of FCC Part 15, Subpart J, Class A.
 - 4. Current edition of BACnet Testing Laboratories (BTL).

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Prepare and submit a detailed schedule of work. Schedule to identify milestones such as equipment submittals, control panel diagrams, color graphic panel displays, Interlock.
 - 2. Wiring diagrams, control program sequence software flow chart diagrams, conduit layout diagrams, device location diagrams, equipment and component deliveries, installation sequencing, controller startup, point to point startup, control programming, sequence testing, commissioning/acceptance testing and training.
 - 3. Submit design drawings, sequences of operation, program listings, software flow charts and details for each typical piece of equipment and system being controlled. No work to be initiated or fabrication of any equipment started prior to the Owner's Authorized Representatives return of REVIEWED submittals.
 - a. Sequence of Operation: The sequence of operation included in the design documents is intended only to communicate the Engineers' general control intent and is not to be used as a direct reference for programming of the EMS system. Verbatim duplication of the Engineer's Sequence of Operation on the submittals is discouraged and may result in non-approval of the submittal. Sequence of operation on submittals to

- accurately detail the system's intended programming, and include details of enhancements, adjustments, or deviations from the Engineer's sequence of operation. Submitted sequence of operation to be written with a logical and organized format and flow. Provide detailed, clear and unambiguous sequence of operation language. Point descriptors and point nomenclature referenced in the submitted sequence of operation to match those (to be) actually programmed. As-built submittal Sequence of Operation to include modifications to the programming made as a result of any addendum, bulletins, RFI's, change orders, and commissioning.
4. Format: Make each submittal in one complete and contiguous package. Partial or unmarked submittals will be rejected without review.
 5. Submit Manufacturers Data as Follows:
 - a. Complete materials list of items proposed to be furnished and installed. A complete Bill of Materials, listing materials, components, devices, wire and equipment are required for this work. The Bill of Materials to be separate for each controller on its own page(s) and to contain the following information for each item listed:
 - 1) Manufacturer's Name and Model number with furnished options highlighted.
 - 2) Quantity of each by controller location.
 - 3) Description of product (generic).
 - 4) Specified item.
 - 5) Operating range or span.
 - 6) Operating point or setpoint.
 - b. Manufacturer's specifications and other data required demonstrating compliance with the specified requirements, including but not limited to: Catalog cuts, technical data and descriptive literature on hardware, software, and system components to be furnished.
 - c. The data to be clearly marked and noted to identify specific ranges, model numbers, sizes, and other pertinent data. Submit printed manufacturer's technical product data for each control device furnished, indicating dimensions, capacities, performance characteristics, electrical characteristics, finishes of materials and including printed installation instructions and start-up instructions.
 - d. Unless specifically called for otherwise, provide bound copies of catalog cuts for standard products, not requiring specifically prepared Shop Drawings, for the following:
 - 1) Wire and Cable, Class II
 - 2) Face Plates for Devices
 - 3) Disconnect Switches for Power Control
 - e. Where more than one item, size, rating or other variations appear on a catalog cut sheet, clearly identify items to be provided. These items to be properly indexed and referenced to identification numbers, designations and/or details on the Drawings.
 6. Shop Drawings: Submit shop drawings for each controlled system, depicting the following information:
 - a. Schematic flow diagram of system showing fans, pumps, coils, dampers, valves and other control/monitoring devices.
 - b. Label each control device with initial setting or adjustable range of control. Label points in schematic diagrams with termination at corresponding controller.
 - c. Electrical Wiring: Clearly differentiate between portions of wiring that are factory installed and portions of be field-installed.
 - d. Details of control panel faces, including controls, instruments, and labeling.
 - e. Interfaces to equipment furnished under other Specification Sections identifying numbers of wires, termination location, voltages and pertinent details. Responsibility for each end of the interfaces to be noted on these drawings whether or not they are a part of this Section.
 - f. System architecture diagram showing the global connectivity of new controllers and any existing systems that will be connected to.

7. Equipment locations, wiring and piping schematics, details, panel configurations, sizes, damper motor mounting details, valve schedules, and a points list keyed to specific hardware submittals. Control wiring depicted as fully annotated ladder diagrams with terminations identified, completely configured as to the exact panel, wiring, relay, switch, and component configuration.
8. Tag Number Lists: Develop instruments tag number system and submit list for approval. Coordinate methods and number block with the Owner's Authorized Representative.
9. Format the Shop and Field Drawings to Include:
 - a. A Title Sheet containing a drawing list, abbreviations list, symbols list, site and vicinity maps for project location and schedules.
 - b. Floor Plans showing proposed device locations and device nomenclatures.
 - c. A Riser Diagram illustrating conduit relationships between devices shown on the Floor Plans. Show device nomenclatures.
 - d. A Single-Line Diagram for each system showing signal relationships of devices within the system. Show device nomenclatures.
 - e. A Wiring Diagram for each assembly, enclosure or free standing device, showing:
 - 1) The Devices Within
 - 2) Wiring Connections
 - 3) Wire Identification
 - 4) Voltage Levels
 - 5) Fuse Ratings
 - f. Operations and Maintenance Manuals:
 - 1) Following approval of Shop Drawings of control equipment and prior to acceptance of control work, prepare Operating and Maintenance manuals describing operating, servicing, and maintenance requirements of control systems and equipment installed under this Section, in accordance the General and Special Conditions of these Specifications.
 - 2) Information contained in the manual for the above equipment to include the following:
 - (a) Manufacturer's catalog cuts and printed descriptive bulletins.
 - (b) Manufacturer's installation, operating, and maintenance instruction booklets. Complete instructions regarding the operation and maintenance of equipment involved.
 - (c) Instrument calibration certificates.
 - (d) Parts list and costs.
 - (e) Complete nomenclature of replaceable parts, list of recommended spare parts for 12 months operation, their part numbers, current cost and name and address of the nearest vendor of replacement parts.
 - (f) Name, address and telephone number for closest source of spare parts.
 - (g) Wiring and schematic diagrams.
 - (h) Include final record copies of shop drawings.
 - (i) Copy of guarantees and warranties issued for the various items of equipment, showing dates of expiration.
 - (j) Reduced plans, diagrams, and control schematics.
 - (k) Copies of test results.
 - (l) Control System Operating Manual including: point of summary and point data base; complete printout of program listings; magnetic tape CD or DVD backup of Field Control Cabinet programs; cabinet layout; hard copy of graphic screens; hard copy of specified reports.
 - g. A final Bill of Quantities including a separate schedule for portable equipment, if delivered as part of this work.
 - h. Performance, Test and Adjustment Data: Comprehensive documentation of performance verification according to parameters specified in these specifications.

- i. Record Drawings: Comply with Division 01, General Requirements and Section 23 00 00, HVAC Basic Requirements. Provide complete as-built submittals including "as-programmed" sequence of operation as well as final occupancy schedules.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Installer Qualifications: Company specializing in performing work of the type specified in this Section with minimum five years' experience in the local area. Installers required to have successfully completed manufacturer's control system factory training.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

- A. Control system referenced throughout specifications and drawings as Building Automation System (BAS), Building Management System (BMS), or Energy Management System (EMS) interchangeably consists of high-speed, peer-to-peer network of DDC controllers, control system server, and operator workstation. System to be UUKL listed if used for smoke control.
- B. System software based on server/thin-client architecture, designed around open standards of web technology. Control system server accessed using a web browser over control system network, Owner's local area network, and remotely over Internet (through Owner's LAN). Intent of thin-client architecture is to provide operators complete access to control system via web browser. No special software other than web browser required to access graphics, point displays, and trends.
- C. Local Area Network (LAN) either 10 or 100 Mbps Ethernet network.
- D. System will consist of open architecture that is capable of:
 - 1. High speed Ethernet communication using TCP/IP protocol.
 - 2. Native BACnet communications according to ANSI / ASHRAE Standard 135, latest edition. Provide necessary BACnet-compliant hardware and software to meet the system's functional specifications. Controller devices must be BTL tested and listed by an official BACnet Testing Laboratory and have the BTL mark issued.
- E. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation valves and dampers.
- F. Prepare individual hardware layouts, interconnection drawings, building riser/architecture diagram and sequence of control from the project design data. Any architecture diagrams on design drawings have been included as schematics only and are not meant to portray quantity of devices or power/data requirements.
- G. Design, furnish, and install equipment cabinets, panels, data communication network infrastructure (including cables, conduits, outlets, connections, etc.) needed, and associated hardware.
- H. Provide complete manufacturer's specifications for items that are supplied. Include vendor name and model number of every item supplied.
- I. Provide a comprehensive operator and technician training program as described in these Specifications.
- J. Provide as-built documentation, operator's terminal software, diagrams, and other associated project operational documentation (such as technical manuals) on approved media, the sum total of which accurately represents the final system.

- K. Provide 120V power, low voltage power, transformers, etc. for control panels, transformer panels, and BAS devices. Install per Division 26, Electrical Specifications. Power for devices within this Specification Section is solely the responsibility of the BAS Contractor.
- L. Conduit and raceway systems. Provide per Division 26, Electrical Specifications.
- M. Devices, components, controllers, and software to be manufacturer's most current version at the time of installation.

1.08 SYSTEM PERFORMANCE

- A. Performance Standards - System conforms to following minimum standards over network connections:
 - 1. Graphic Display: Graphic with 20 dynamic points display with current data within 10 seconds.
 - 2. Graphic Refresh: Graphic with 20 dynamic points update with current data within 8 seconds.
 - 3. Object Command: Devices react to command of binary object within 2 seconds. Devices begin reacting to command of analog object within 2 seconds.
 - 4. Object Scan: Data used or displayed at controller or workstation have been current within previous 6 seconds.
 - 5. Alarm Response Time: Object that goes into alarm is annunciated at workstation within 45 seconds.
 - 6. Program Execution Frequency: Custom and standard applications are capable of running as often as once every 5 seconds. Select execution times consistent with mechanical process under control.
 - 7. Performance: Programmable controllers are able to completely execute DDC PID control loops at frequency adjustable down to once per second. Select execution times consistent with mechanical process under control.
 - 8. Multiple Alarm Annunciation: Each workstation on network receive alarms within 5 seconds of other workstations.
- B. Reporting Accuracy: System reports values with minimum end-to-end accuracy listed in Reporting Accuracy Table below.
 - 1. Reporting Accuracy Table:

Measure Variable	Reported Accuracy
Space Temperature	Plus or Minus 1 degree F
Ducted Air	Plus or Minus 1 degrees F
Outside Air	Plus or Minus 2 degrees F
Dew Point	Plus or Minus 3 degrees F
Water Temperature	Plus or Minus 1 degree F
Delta-T	Plus or Minus 0.25 degree F
Relative Humidity	Plus or Minus 5 percent RH
Water Flow	Plus or Minus 2 percent of full scale

- 2. Note 1: Accuracy applies to 10 percent-100 percent of scale
- 3. Note 2: For both absolute and differential pressure
- 4. Note 3: Not including utility-supplied meters
- C. Control Stability and Accuracy. Control loops maintain measured variable at setpoint within tolerances listed in Control Stability and Accuracy Table below.
 - 1. Control Stability and Accuracy Table:

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	Plus or minus 0.2 inch wg	0-6 inch wg
	Plus or minus 0.01 inch wg	-0.1 to 0.1 inch wg

Airflow	Plus or minus 10 percent of full scale	
Space Temperature	Plus or minus 2.00 degrees F	
Duct Temperature	Plus or minus 3.0 degrees F	
Humidity	Plus or minus 5 percent RH	
Fluid Pressure	Plus or minus 1.5 PSI	1-150 PSI
	Plus or minus 1.0 inch wg	0-50 inch wg differential

PART 2 - PRODUCTS

2.01 NORTHERN CALIFORNIA MANUFACTURERS

- A. Alerton
- B. Automated Logic
- C. Delta Controls
- D. Schneider Electric
- E. Duct/Spot-Type Smoke Detectors (Project with Fire Alarm System):
 - 1. See Division 28 for Products.

2.02 COMMUNICATIONS

- A. Each controller to have communication port for connection to operator interface.
 - 1. Internetwork operator interface and value passing to be transparent to internetwork architecture.
 - 2. Operator interface connected to controller to allow operator to interface with each internetwork controller as if directly connected. Controller information such as data, status, reports, system software, and custom programs to be viewable and editable from each internetwork controller.
- B. Inputs, outputs, and control variables used to integrate control strategies across multiple controllers to be readable by each controller on internetwork.
- C. Operator Workstation to be capable of simultaneous direct connection and communication with BACnet/IP, OPC and TCP/IP networks without use of interposing devices such as PC or gateway with hard drive.
- D. Workstations, Building Control Panels and Controllers with real-time clocks use time synchronization service. System automatically synchronizes system clocks daily from operator-designated device via internetwork. System automatically adjusts for daylight savings and standard time as applicable.
- E. Wireless Network Communications:
 - 1. Wireless communications take place using modular wireless transceivers at each device, which eliminates need for communication cabling.
 - 2. Wireless transceiver utilizes 2.4 GHz in license free global Industrial Scientific and Medical (ISM) band.
 - 3. Wireless transceiver is encased in plenum-rated enclosure. If application dictates, wireless transceiver is able to be installed in metal enclosure utilizing remote mounted antenna.
 - 4. Wireless transceiver channel is factory set and capable of being field set to different channel if interference with IEEE 802.11 devices or other 2.4 GHz products is encountered.
 - 5. Wireless transceiver is 24 VAC powered.
 - 6. Wireless transceiver gives a visual indication that it is powered and communicating.
 - 7. Wireless transceiver has a field-settable network identifier that allows multiple networks to occupy same channel for maximum scalability.

2.03 OPERATOR INTERFACE

- A. Operator Interface: PC-based workstations reside on high-speed network with building controllers. Each workstation or each standard browser connected to server is able to access system information.
- B. Hardware: Each operator workstation or web server consists of the following:
 - 1. Computer: Hardware meets or exceeds DDC system manufacturer's recommended specifications and meet response times specified elsewhere in this document. Following hardware requirements also apply:
 - a. Hard disk have sufficient memory to store:
 - 1) Required operator workstation software.
 - 2) One year of trend data based on points specified to be trended at specified trend intervals.
 - b. Minimum hardware configuration includes:
 - 1) Intel i7 Processor
 - 2) 22-in LCD Monitor with at least 1024 x 768 Resolution
 - 3) 8 GB of RAM
 - 4) 48x CD-RW/DVD Optical Drive
 - 5) 1 TB Hard Disk Drive Providing Data at 3 GB/sec
 - 6) Ethernet 10/100 Network Interface Card
 - 7) High Performance Graphics Card
 - 8) Keyboard and Mouse
 - 9) Color Inkjet Printer
 - 10) UPS (uninterruptible power supply) installed at server, sized with sufficient capacity to allow full operation for 10 minutes or more.
 - 2. Modem: Auto-dial modem and associated cables transmit over voice-grade telephone lines at nominal 56Kb between workstation or web server and remote buildings and workstations.
 - 3. Portable Operator's Terminal: Portable Operator's Terminal capable of accessing system data. This device may be connected to any point on system network or to any controller for programming, setup, and troubleshooting. Portable Operator's Terminal is IBM-compatible notebook-style PC including software and hardware required. PC contains at minimum:
 - a. Intel i5 Processor
 - b. 15-in LCD Monitor with at least 1024 x 768 Resolution
 - c. 8 GB of RAM
 - d. 1 TB Hard Drive
 - e. Touch-Pad or Other Internal Pointing Device
 - f. High-Performance Graphics Adapter
 - g. Ethernet 10/100 Network Interface Card
 - h. Integrated Wireless 802.11 b/g/n
 - i. Serial Port and CD/RW-ROM
 - j. Internal Modem, 56Kb Minimum
- C. System Software:
 - 1. Operating System: Furnish concurrent multi-tasking operating system. Operating system also supports use of and includes other common software applications such as Microsoft Excel, Word, Microsoft Access and Adobe Acrobat. Acceptable operating systems are Windows 7 and Windows 10.
 - 2. Dynamic Color Graphics:
 - a. Real-time color graphic displays dynamic and able to update displays.
 - b. Provide operator ability to change values (setpoints) and states in system controlled equipment directly from graphic display.
 - c. Custom Graphics. Provide custom graphics generation package.

- d. Graphics Library. Furnish library of standard HVAC equipment graphics and include standard symbols for fans, pumps, coils, valves, piping, dampers, and ductwork.
- 3. Software to be manufacturer's most current version at the time of installation.
- D. System Applications: Each workstation provides operator interface and off-line storage of system information. Provide following applications at each workstation:
 - 1. Automatic System Database Save and Restore: Each workstation stores on hard disk copy of current database of each Building Controller. This database automatically updated whenever change is made in any system panel.
 - 2. Manual Database Save and Restore: System operator able to manually save or clear database and initiate download of specified database from/to any panel.
 - 3. System Configuration: Workstation software provides method of configuring system to allow for changes or additions by users and performs following tasks:
 - a. Create, delete or modify control strategies.
 - b. Add/delete objects to system.
 - c. Tune control loops through adjustment of control loop parameters.
 - d. Enable or disable control strategies.
 - e. Generate hard copy records of control strategies on printer.
 - f. Select points to be alarmed and define alarm state.
 - g. Select points to be trended and initiate automatic recording of values.
 - h. Start/Stop binary objects and adjust analog objects.
 - 4. Security: Operator required to log on to system with user name and password in order to view, edit, add, or delete data. System security selectable for each operator.
 - 5. System Diagnostics: System automatically monitor operation of workstations, printers, modems, network connections, building management panels, and controllers. Failure of any device to be annunciated.
 - 6. Alarm Indication and Handling:
 - a. Workstation provides visual means of alarm indication. Alarm indication becomes highest priority regardless of application(s) running.
 - b. System provides and archive log of alarm messages to hard drive. Alarm messages to include description of event-initiating object, source, location and time/date of alarm.
 - 7. Trend Logs: Operator able to define custom trend log for any data object and include interval, start time, and stop time. Trend data sampled and stored on building controller panel, is archived on hard disk, and is retrievable for use in spreadsheets and standard database programs.
 - a. System server to periodically gather historically recorded data stored in the building controllers and archive the information. Archived files to be appended with new sample data, allowing samples to be accumulated.
 - b. Software to be included that is capable of graphing the trend logged object data. Software capable of creating two-axis (x,y) graphs that display object values relative to time.
 - c. Operator able to change trend log setup information. This includes the information to be logged as well as the interval at which it is to be logged. Input, output, and value object types in the system may be logged. Provide operations password protected. Setup and viewing may be accessed directly from any graphics on which object is displayed.
 - d. BAS Contractor to enable trending for any system points (physical or virtual) as directed by the Engineer, Owner or Commissioning Authority (Commissioning Authority). There will be no limit on the number of trended points the BAS Contractor is to set up. BAS Contractor will modify trend setup parameters as directed by the Commissioning Authority during testing. BAS Contractor to be proactive and enable trending for major system points during system startup/programming. BAS Contractor is not to wait for direction to begin trending points. Trend data for each point to be archived on the main server for a minimum of one year. Trend data archiving to be

- enabled immediately upon trend setup, or as soon as communication between the field panel and sever is established. Trend data uploads from field panel to server set up to be automatically performed with sufficient frequency to ensure no data gaps or loss of trend data.
- e. Trend points as identified in the points list. Provide system specific trend data in two-axis (x,y) graphs that display object values relative to time to Engineer, Owner, or Commissioning Authority.
- 8. Standard Reports: Standard system reports provided for this project. Provide ability for Owner to readily customize these reports for this project:
 - a. Objects: System (or subsystem) objects and their current values.
 - b. Logs:
 - 1) Alarm History
 - 2) System Messages
 - 3) System Events
 - 4) Trends
- E. Interfaces to Third Party Systems: BAS connects to third party systems (VFDs, chillers, emergency generators, rooftop AC units, etc.). Communication protocol specified for third party system, and BAS provides compatible protocol to assure proper two way communication. Points, alarms, and commands displayed on BAS as indicated.
- F. Workstation Applications Editors: Each PC workstation supports editing of system applications, which downloaded and executed at one or more controller panels.

2.04 CONTROLLER SOFTWARE

- A. Furnish following applications software for building and energy management. Software applications reside and operate in system controllers. Software to be manufacturer's most current version at the time of installation. Software and associated functions (scheduling, optimum start/stop, etc.) noted in this specification are to be configured and enabled for this project. Incorporate into sequence of operation submittals for review prior to installation.
- B. System Security:
 - 1. User access secured using individual security passwords and user names.
 - 2. Record user Log On/Log Off attempts.
 - 3. Provide passwords, user names, and access assignments adjustable at the operator's terminal. Each user to have a set security level, which defines access to displays and individual objects the user may control. System to include 10 separate and distinct security levels for assignment to users.
 - 4. System to include an Auto Logout Feature that will automatically logout user when there has been no keyboard or mouse activity for a set period of time. Time period to be adjustable by system administrator. Auto Logout may be enabled and disabled by system administrator. Operator terminal to display message on screen that user is logged out after Auto Logout occurs.
- C. Scheduling: Provide capability to schedule each object or group of objects in system. Coordinate schedule with Owner and program accordingly. Each schedule consists of:
 - 1. Operator's workstation to show information in easy-to-read daily format. Priority for scheduling: Events, holidays and daily with events being the highest.
 - 2. Holiday and special event schedules to display data in calendar format. Operator able to schedule holidays and special events directly from these calendars.
 - 3. Operator able to change information for a given weekly or exception schedule if logged on with the appropriate security access.
- D. Optimum Start/Stop: Provide software and program system to start equipment on sliding schedule based upon indoor and outdoor conditions. Determine minimum time of HVAC system operation needed to satisfy space environmental requirements and also determine earliest possible time to stop mechanical systems (i.e. shut down cooling/heating and only provide

ventilation one hour prior to scheduled unoccupied period.) Optimum start/stop program operates in conjunction with scheduled start/stop and night setback programs.

E. Alarms:

1. Operator's workstation to provide visual means of alarm indication. The alarm dialog box to always become the top dialog box regardless of the application(s), currently running.
2. System to provide log of alarm messages. Alarm log to be archived to the hard disk of the system operator's terminal. Each entry to include a description of the event-initiating object generating the alarm. Entry to include time and date of alarm occurrence.
3. Alarm messages in user-definable text and entered either at the operator's terminal or via remote communication.
4. Each binary object set to alarm based on operator-specified state.
5. Each analog object have both high and low alarm limits.
6. Alarms must be able to be automatically and manually disabled.
7. Alarms are routed to appropriate workstations based on time and other conditions. An alarm is able to start programs, print, be logged in event log, generate custom messages, and display graphics.
8. System have ability to dial out in event of alarm.
9. Alarm Levels:
 - a. Provide 5 levels of alarm as follows, and program alarm levels for every required and specified alarm:
 - 1) Level 1: Critical/life safety.
 - 2) Level 2: Significant equipment failure.
 - 3) Level 3: Non-critical equipment failure/operation.
 - 4) Level 4: Energy conservation monitor.
 - 5) Level 5: Maintenance indication, notification.
 - b. Prior to training of Owner's Authorized Representative, submit the complete Points List and suggested Alarm Levels to the Owner.
 - c. During training of Owner's Authorized Representative(s):
 - 1) Discuss Alarm Levels and the alarms currently included in the BAS.
 - 2) Provide additional alarms without addition of new hardware points, as required by Owner's Authorized Representative.
 - 3) Agree with the Owner's Authorized Representative on action(s) to be taken for each alarm level and implement same for each alarm. Said action to include visual and/or audible alarm(s) at the Operator workstation including whether Operator acknowledgement is required or not, email messages, and text messages.

F. Demand Limiting:

1. System to include demand limiting program that includes two types of load shedding. One type of load shedding to shed/restore equipment in binary fashion based on energy usage when compared to shed and restore settings. The other type of shedding to adjust operator selected control setpoints in an analog fashion based on energy usage when compared to shed and restore settings. Shedding may be implemented independently on each and every zone or piece of equipment connected to system.
2. Status of each and every load shed program capable of being displayed on every operator terminal connected to system. Status of each load assigned to an individual shed program displayed along with the description of each load.
3. Demand-limiting program monitor building power consumption from signals generated by pulse generator (provided by BAS contractor) mounted at building power meter or from watt transducer or current transformer attached to building feeder lines.
4. Demand-limiting program predicts probable power demand so that when demand exceeds demand limit, action will be taken to reduce loads in predetermined manner. When demand limit will not be exceeded, action will be taken to restore loads in predetermined manner.

- G. Maintenance Management: System monitors equipment status and generate maintenance messages based upon user-designated run-time, starts, and/or calendar date limits. Coordinate settings with Owner.
- H. Sequencing: Provide application software based upon sequences of operation specified to properly sequence designated systems. Provide points to achieve specified sequences.
- I. Staggered Start: This application prevents controlled equipment from simultaneously restarting after a power outage. Order in which equipment (or groups of equipment) is started, along with time delay between starts to be user-selectable.
- J. Energy Calculations: Provide software to allow instantaneous power (e.g. kW) or flow rates (e.g. L/s (gpm)) to be accumulated and converted to energy usage data.
- K. Anti-Short Cycling: Binary output objects protected from short cycling by allowing minimum on-time and off-time to be selected.
- L. On/Off Control with Differential: Provide algorithm that allows binary output to be cycled based on controlled variable and setpoint. Algorithm direct-acting or reverse-acting and incorporate adjustable differential.
- M. Run-Time Totalization: Provide software to totalize run-times for binary input objects.

2.05 WEB BASED ACCESS

- A. General Description: BAS supplier to provide web-based access to the system as part of standard installation. Provide access to user of displays of real-time data that are part of the BAS via a standard Web browser. Web browser to tie into the network via Ethernet network connection. Provide web-page host that resides on the BAS network. Web-page software not to require a per user licensing fee or annual fees. The web-page host must be able to support at least 50 simultaneous users with the ability to expand the system to accommodate an unlimited number of users. Software to be manufacturer's most current version at time of installation.
- B. Browser Technology: Browser to be standard version of Microsoft Internet Explorer (latest edition). No special vendor-supplied software needed on computers running browser. Displays viewable and the Web-page host to directly access real-time data from the BAS network. Data displayed in real time and update automatically without user interaction. User able to change data on displays if logged in with the appropriate user name and password.
- C. Display of Data: Web page graphics shown on browser to be replicas of the BAS displays. User to need no additional training to understand information presented on Web pages when compared to what is shown on BAS displays. Web page displays to include animation just as BAS displays. Fans to turn, pilot lights to blink, and coils to change colors, and so on. Real-time data shown on browser Web pages. This data must be directly gathered via the BACnet network and automatically updated on browser Web page displays without any user action. Data on the browser to automatically refresh as changes are detected without re-drawing the complete display. User to be able to change data from browser Web page to if the user is logged on with the appropriate password. Clicking on a button or typing in a new value to change digital data. Using pull-down menus or typing in a new value to change analog data. Data displays navigated using pushbuttons on the displays that are simply clicked on with the mouse to select a new display. Alternatively, the standard back and forward buttons of the browser can be used for display navigation.
- D. Web Page Generation: Web pages generated automatically from the BAS displays that reside on the BAS server. User to access Web-page host via the network and initiate a web page generation utility that automatically takes the BAS displays and turns them into Web pages. The Web pages generated are automatically installed on the Web page host for access via any computer's standard browser. Any system that requires use of an HTML editor for generation of Web pages will not be considered.
- E. Password Security and Activity Log: Access via Web browser to utilize the same hierarchical security scheme as BAS system. User asked to log in once the browser makes connection to Web-page host. Once the user logs in, any changes that are made to be tracked by the BAS

system. User able to change only those items that the user has authority to change. A user activity report to show any activity of the users that have logged in to the system regardless of whether those changes were made using a browser or via the BAS workstation.

- F. Communication: Web-page host to communicate using the specified protocol standard to devices on the BAS network.

2.06 BAS GRAPHICS

- A. Develop customized graphics showing the project building(s) and their floor plans, mechanical, and electrical equipment, flow and control diagrams, and other relevant features on Workstation graphic screens. Associated input, output, and virtual objects (e.g., temperature and pressure setpoints) listed in the Sequence of Operation, and shown on the Input/Output Objects List included in the graphic screens and bound to the database. Real-time value of objects updated on the display of each graphic automatically. For projects where existing campus and/or building controls systems exist, replicate graphics used in the existing BAS graphics screens.
- B. Graphics to have links to the Print function and to display a Standard Legend in the corner of the graphic. Graphics, except pop-ups, to have the date and time displayed in the upper corner of the graphic. Each graphic titled.
- C. Weather: Graphics, except pop-ups, to have the outdoor temperature and humidity in the upper corner of the graphic.
- D. Alarms: System and component summary alarms located near the top of each relevant graphic screen. Provide links to the associated system/component as part of these tags to assist trouble shooting. Other alarms placed near the associated system/device as depicted in the graphic. Provide text and color of information tags that describe each object and alarm value consistent with a graphics color legend.
- E. The Following Graphics Provided as a Minimum:
 - 1. A building graphic, typically a photograph of the building, with links to each floor plan and other links as defined below.
 - 2. A central plant graphic with equipment (chillers, boilers, pumps, heat exchangers, storage tanks, etc.), temperature sensors, pressure sensors, flow sensors and refrigeration leak detectors. The central plant graphic to have links to each building on the campus.
 - 3. Central equipment such as air handler, package rooftop equipment, supply fans, exhaust fans, and smoke control systems.
 - 4. Floor plans of each floor, with temperature sensors, pressure sensors, temperature control zones, heating/cooling zones, ventilation zones, and supply air zones identified. Rooms grouped on a graphic only to the extent that detailed and complete sensing information can be comfortably viewed by an operator and the bound points updated in less than 10 seconds. Each zone to have a temperature symbol that changes color over the range from low (blue) through normal (green) to high (red) and indicate an alarm (flashing red). The zone temperature and or pressure symbol(s) to be a link to a zone control pop-up graphic. Individual floor plan graphics to provide links to related mechanical systems. The mechanical room plan graphics to show the relative location of, and provide links to, either the equipment pop-up or flow and control graphic for mechanical equipment monitored or controlled by the BAS.
 - 5. Pop-up graphics provided for each zone control system showing a flow diagram and related monitoring and control points and system parameters. Pop-up graphics provided for each piece of equipment that is not shown on a flow and control graphic.
 - 6. Flow and control diagrams for each system including but not limited to central plant, fan coils, generators, packaged equipment, chilled water systems, heating hot water systems, heat exchangers, pumps, storage tanks, zone terminal units, isolation room systems, smoke damper status, combination fire and smoke damper status, and ventilation systems. The flow and control graphics to have parameters grouped in the lower portion of the graphics. Standard equipment graphics used. Pumps, fans, dampers and other elements to dynamically indicate their state (i.e. pumps and fans to rotate when on and damper positions to dynamically adjust and be shown in their current position, etc.).

System flow and control graphics displayed in a general left to right flow or loop arrangement. Return and exhaust air flow shown on top and return water shown on the bottom of the graphic.

7. Individual equipment/component screens showing sensing and control information available for each device provided.
- F. Penetration: The graphic interface to consistently apply a convention whereby a left-click to always penetrate to more detailed information. The text windows to represent the deepest level of penetration. A right-click to always produce a menu of options that are specific to the item selected.
- G. Navigation: Graphics organized to provide a "branching structure" that allows an operator to move from a "macro view" to a "micro view" and return. These links to other associated graphics, or allow a return to a previous macro view, provided and arranged horizontally along the bottom of each graphic screen. From left to right, the graphic links as follows: site/building map, building/trailer floor plans, and major mechanical systems at each building. Pop-up right click menus provided as needed on the lower button bar to allow for uncluttered navigation.
- H. Clutter Minimization: Each graphic to have separate check boxes in the lower right corner that show/hide setpoints, alarms/safeties, and devices/equipment.
- I. Templates: To the maximum extent possible, use standard graphics as templates to provide a consistent look throughout the interface.
- J. Color Scheme: The graphics to use dynamic color changes to communicate equipment type, or object status consistent with the graphics color legend.
- K. Symbols and Animations: Fans, pumps, dampers, coils, and generation equipment to be dynamic symbols indicating rotation, state, or position, movement, flow, etc.
- L. Macros: When macros are used to add functionality to the graphics, detailed documentation provided.
- M. Configure Mode: Access to "Configure Mode" for editing of the graphics password protected to prevent unauthorized changes to the graphics. This password supplied to the appropriate personnel.
- N. Graphics Version: Graphics provided in the most current format available at time of control system programming.
- O. Points and graphics checked for the proper binding and graphic programming, settings to ensure that the correct system, location, point values and dynamics are shown in the proper location and rotate in the proper directions.
- P. After graphics have been accepted, provide, on a CD ROM in an agreed upon file structure. If the graphics have active-x controls or other files that must be placed outside the graphics folder structure a set-up program provided on the disk to place the files in the correct locations.

2.07 BUILDING CONTROLLERS

- A. General: Provide adequate number of building controllers to achieve performance specified. Panels to meet the following requirements.
 1. Building Automation System (BAS) to be composed of one or more independent, stand-alone, microprocessor-based building controllers to manage global strategies described in Controller Software article.
 2. Provide sufficient memory to support operating system, database, and programming requirements.
 3. Share data between networked building controllers.
 4. Distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
 5. Controllers that perform scheduling have real-time clock.
 6. Continually check status of its processor and memory circuits and if abnormal operation is detected, controller:

- a. Assume predetermined failure mode.
 - b. Generate alarm notification.
- 7. Building Controller communicates with other devices on internetwork including BACnet communications according to specified protocol.
- B. Communication:
 - 1. Each building controller resides on network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol and performs routing to network of custom application and application specific controllers.
 - 2. Controller provides a service communication port for connection to a portable operator's terminal.
- C. Environment:
 - 1. Controllers used outdoors and/or in wet ambient conditions mounted within NEMA waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
 - 2. Controllers used in conditioned space are mounted in NEMA dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.
- D. Keypad: Local keypad and display to be provided for each controller. Security password to be available to prevent unauthorized use of keypad and display.
- E. Serviceability: Provide diagnostic LEDs for power, communication, and processor. Wiring connections are made to modular terminal strips or to termination card connected by ribbon cable.
- F. Memory: Building controller maintains BIOS and programming information in event of power loss for at least 72 hours.
- G. Immunity to power and noise. Controller able to operate at 90 percent to 110 percent of nominal voltage rating and performs an orderly shutdown below 80 percent nominal voltage. Operation protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3-feet.
- H. Controller to have a battery to provide power for orderly shutdown of controller and storage of data in nonvolatile flash memory. Battery backup to maintain real-time clock functions for a minimum of 10 days.

2.08 APPLICATION SPECIFIC CONTROLLERS

- A. Application specific controllers (ASCs) are microprocessor-based DDC controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers to be fully programmable using graphical programming blocks.
 - 1. ASC controllers communicate with other devices on internetwork.
 - 2. Each ASC capable of stand-alone operation without being connected to network.
 - 3. Each ASC will contain sufficient I/O capacity to control target system.
 - 4. Application controllers to include universal inputs with minimum 10-bit resolution that accept thermistors, 0-10VDC, 0-5 VDC, 4-20 mA and dry contact signals. Any input on a controller may be either analog or digital with at least 1 input that accepts pulses. Controller to also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller to include binary and analog outputs on board. Provide analog outputs switch selectable as either 0-10VDC or 0-20mA. Software to include scaling features for analog outputs. Application controller to include 24VDC voltage supply for use as power supply to external sensors.
 - 5. Program sequences stored on board application controller in EEPROM. No batteries needed to retain logic program. Program sequences executed by controller 10 times per second and capable of multiple PI and PID loops for control of multiple devices. Calculations completed using floating-point math and system to support display of information in floating-point nomenclature at operator's terminal. Programming of application controller completely modifiable in the field over installed BAS LANs or remotely via modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen.

6. Application controller to include support for room sensor. Display on room sensor programmable at application controller and include an operating mode and a field service mode. Provide button functions and display data programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence of operation for specific display requirements at intelligent room sensor.
- B. Communication:
 1. Controller resides on network using MS/TP Data Link/Physical layer protocol.
 2. Each controller connected to building controller.
 3. Each controller capable of connection to laptop computer or portable operator's tool.
 - C. Environment:
 1. Controllers used outdoors and/or in wet ambient conditions mounted within NEMA waterproof enclosures and rated for operation at 0 degrees F to 150 degrees F.
 2. Controllers used in conditioned space mounted in NEMA dust-proof enclosures and rated for operation at 32 degrees F to 120 degrees F.
 - D. Serviceability: Provide diagnostic LEDs for power, communication, and processor.
 - E. Memory: ASC use nonvolatile memory and maintains BIOS and programming information in event of power loss.

2.09 APPLICATION SPECIFIC CONTROLLER - TERMINAL UNIT CONTROLLERS

- A. Provide one application controller for each terminal unit that adequately covers objects listed in object list for unit. Controllers to interface to building controller via LAN using specified protocol. Controllers to include on board flow sensor, inputs, outputs and programmable, self-contained logic program as needed for control of units.
- B. Application controllers to include universal inputs with 10-bit resolution that can accept thermistors, 0-5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller to also include support and modifiable programming for interface to intelligent room sensor with digital display (digital display to indicate setpoint only). Controller to also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller to include microprocessor driven, self calibrating flow sensor for use in pressure independent control logic. Terminal units controlled using pressure independent control algorithms and flow readings to be in CFM. Flow sensor and controller to have control range of 0.004 in.wc. to 1.5 in.wc. with an accuracy of +5% at 1 in.wc.
- C. Program sequences stored on board application controller in EEPROM. No batteries needed to retain logic program. Program sequences executed by controller 10 times per second and capable of multiple PI loops for control of multiple devices. Provide programming of application controller completely modifiable in the field over installed specified protocol LANs or remotely via modem interface. Operator to program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller programmed using the same programming tool as Building Controller and as described in Operator Workstation article.
- D. Application controller to include support for intelligent room sensor. Display on room sensor programmable at application controller and include an operating mode and a field service mode. Button functions and display data programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.
- E. Provide duct temperature sensor at discharge of each terminal unit that is connected to controller for reporting back to operator workstation. Provide analog inputs for the duct temperatures.

2.10 INPUT/OUTPUT INTERFACE

- A. Input/output points protected such that shorting of point to itself, to another point, or to ground will cause no damage to controller. Input and output points protected from voltage up to 24 V.

- B. Binary inputs (BI or DI) allow monitoring of On/Off signals from remote devices. Binary inputs sense “dry contact” closure without external power (other than that provided by controller) being applied.
- C. Pulse accumulation input objects accept up to 10 pulses per second for pulse accumulation.
- D. Analog inputs (AI) allow monitoring of low-voltage (0 to 10 VDC), current (4 to 20 mA), or resistance signals (thermistor, RTD).
- E. Binary outputs (BO or DO) provide for On/Off operation or pulsed low-voltage signal for pulse width modulation control. Binary outputs on building and custom application controllers have three-position (On/Off/Auto) override switches and status lights. Outputs selectable for either normally open or normally closed operation.
- F. Analog outputs (AO) provide a modulating signal for control of end devices. Outputs provide either a 0 to 10 VDC or a 4 to 20 mA signal as required to provide proper control of the output device. Analog outputs on building controllers have status lights and two-position (AUTO/MANUAL) switch and adjustable potentiometer for manual override. Analog outputs not exhibit drift of greater than 0.4 percent of range per year.
- G. Tri-State Outputs. Provide tri-state outputs (two coordinated binary outputs) for control of three-point floating type electronic actuators without feedback. Use of three-point floating devices limited to zone control and terminal unit control applications (VAV terminal units, duct-mounted heating coils, zone dampers, radiation, etc.). Control algorithms run zone actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.11 POWER SUPPLIES AND LINE FILTERING

- A. Control transformers UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in both primary and secondary circuits. Limit connected loads to 80 percent of rated capacity.
- B. DC power supply output match output current and voltage requirements. Unit operates between 32 degrees F and 120 degrees F.
- C. Line voltage units UL listed and CSA approved.
- D. Power line filtering. Provide transient voltage and surge suppression for workstations and controllers.

2.12 CONTROL PANELS

- A. Control Panels:
 1. Enclosures may be NEMA 1 when located in a clean, dry, indoor environment. Indoor enclosures to be NEMA 12 when installed in other than a clean environment. Outdoor enclosures must be NEMA 3R. Provide (hinged door) key-lock latch and removable subpanels. Single key common to field panels and subpanels. In existing campus or building settings, key lock to match existing keys.
 2. Interconnections between internal and face-mounted devices prewired with color-coded stranded conductors neatly installed in plastic troughs and/or tie-wrapped. Terminals for field connections UL listed for 600 volt service, individually identified per control/ interlock drawings, with adequate clearance for field wiring. Control terminations for field connection individually identified per control drawings.
 3. Provide ON/OFF power switch with overcurrent protection for control power sources to each local panel.
 4. Provide laminated plastic nameplates for enclosures in any mechanical room or electrical room labeled with TCP number. Laminated plastic to be 1/8-inch thick sized appropriately to make label easy to read.

2.13 AUXILIARY CONTROL DEVICES

- A. Temperature Instruments:
 1. Low-voltage or Line-voltage Thermostats: Bimetal-actuated, snap acting SPDT contact, enclosed, UL listed for electrical rating, exposed setpoint adjustment on cover with heat

anticipator. Thermostat operates within 55 degrees F to 85 degrees F setpoint range, with 2 degrees F maximum differential.

2. Room Temperature Sensors: Thermistor or platinum RTD type with accuracy of plus or minus 0.5 degrees F at 70 degrees F; operating range 30-120 degrees F; linear signal; single point sensing element in wall-mounted ventilated enclosure with insulating back plate if mounted on exterior wall; plug-in portable operators terminal port.
 3. Room Temperature Sensor: Thermistor or platinum RTD type with accuracy of plus or minus 0.5 degrees F at 70 degrees F; operating range 30-120 degrees F; linear signal; single point sensing element in wall-mounted ventilated enclosure with insulating back plate if mounted on exterior wall; push button for occupancy override; digital setpoint adjustment plus or minus 2 degrees F in both directions; LCD temperature display indicating setpoint only. Setpoint adjustment to revert to building programmed standard temperature upon next building occupancy schedule change (user adjustable). Room temperature sensor may have integral space carbon dioxide sensor with minimum performance characteristics identified within this specification. Include integral occupancy sensor for public rooms but not in offices.
 4. Averaging Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F, consisting of array of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 1-foot element per 2 SF of duct cross-sectional area. Use when duct is 9 SF or larger or where air is subject to temperature stratification.
 5. Probe Duct Temperature Sensors: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F, consisting of single point sensing elements, securely mounted in duct or plenum; operating range 20-120 degrees F; linear signal; 24-inch rigid probe. Use where duct is less than 9 SF cross-sectional area.
 6. Outside Air Temperature Sensor: Thermistor or platinum RTD element with accuracy of plus or minus 0.5 degrees F at 32 degrees F; Range -58 to 120 degrees F, single element, linear, with weather and sun shield for exterior mounting.
 7. Low Temperature Limit Thermostat: Minimum 20 foot capillary sensing element, triggering on low temperature as sensed by any 12-inch segment; snap acting, normally open contacts, manual reset, line voltage.
- B. Humidity Sensors:
1. Space Humidity Sensors: Operating range 10 to 95 percent relative humidity, accuracy plus or minus percent RH, surface mounted ventilated enclosure for wall mounting.
 2. Duct Humidity Transmitter: Capacitive type sensor and transmitter, linear output signal; automatic temperature compensating; air filter; plus or minus 2 percent RH accuracy from 0 to 100 percent RH.
 3. Humidity sensor's drift not exceed 1 percent of full scale per year.
- C. Dewpoint Transmitter:
1. Uninterrupted, accurate and stable dewpoint measurement in condensing environments. Provide with integral temperature sensor.
 2. Calculate:
 - a. Relative Humidity
 - b. Absolute Humidity
 - c. Difference between ambient and dewpoint temperature.
 - d. Mixing Ratio of Air
 - e. Wet Bulb Temperature of Air
 3. Provide hand held field calibration.
 4. Provide with local display and connection to BAS (analog output signal from device to BAS 4-20 mA signal).
 5. Dust and Chemical Resistant
 6. NEMA 4 Housing
 7. NIST Traceable with Certificate
 8. Specifications:

- a. Dewpoint Measurement Range:-40 degrees F to 212 degrees F
 - b. Response Time: 15 seconds
 - c. Temperature Measurement Range:40 degrees F to 356 degrees F
 - d. Accuracy: 0.18 degrees F
 - e. Typical Ranges:
 - 1) Relative Humidity: 0 to 100 percent
 - 2) Dewpoint Difference: 0 to 90 degrees F
 - 3) Mixing Ratio: 0 to 3500 gr/lb
 - 4) Absolute Humidity: 0 to 262 gr/ft³
 - 5) Wet Bulb Temperature: 32 degrees F to 212 degrees F
 - 9. Manufacturers:
 - a. Vaisala HMP243 with HMK41 field calibrator.
 - b. Or approved equivalent.
- D. Pressure Transmitters and Transducers:
- 1. Transducer have linear output signal; field adjustable zero and span. Sensing elements withstand continuous operating conditions of positive or negative pressure 50 percent greater than calibrated span without damage.
 - 2. Filter Differential Pressure Switch: Setpoint adjustable with operating range of 0.1 to 5-inch WG; auto reset. Contactor to close when pressure differential setting is met or exceeded. Provide mounting bracket, metallic tubing and appropriate fittings for connection to duct or air-handling unit.
 - 3. Duct Static Differential Pressure Transducer: Operating range 0 to 5-inch WC for duct mounted transmitter; ceramic capacitive sensing element with probe securely mounted in duct; digital input terminal and push button to zero output. Accuracy plus or minus 1 percent of full scale; maximum response time 2 seconds.
 - 4. Piping Pressure Transmitter: Operating range 0 to 50 PSIG, linear signal; stainless steel diaphragm; digital input terminal and push button to zero output. Accuracy plus or minus 1 percent of full scale.
- E. Motorized Control Dampers:
- 1. Performance: Maximum leakage of 3 CFM/SF at 1-inch WG differential pressure, AMCA Class 1A, maximum pressure rating of 13-inch WG differential pressure, maximum velocity of 6,000 fpm, -72 degrees F to 275 degrees F temperature rating.
 - 2. Multi-blade type, except where either dimension is less than 10-inch single blade may be used. Maximum blade length to be 48-inch.
 - 3. Provide parallel blades for modulating mixing service and opposed blades for throttling service.
 - 4. Blades to be interlocking; minimum 16 gauge galvanized steel; compression type edge seals and side seating stops. In copper, aluminum and stainless steel duct work, damper material matches duct work material.
 - 5. Damper blades are reinforced, have continuous full length axle shafts, axle to axle linkage, and/or operating "jackshafts" as required to provide coordinated tracking of blades.
 - 6. Bearings: Self-lubricating stainless steel sleeve or Celcon bearing.
 - 7. Dampers over 25 SF in area to be in two or more sections, with interconnected blades.
 - 8. Provide remote damper blade position status with binary input.
 - 9. Tested in accordance with AMCA Standard No. 500.
- F. Motorized Control Valves:
- 1. Body pressure rating and connection type construction conforms to pipe, fitting and valve schedules.
 - 2. Fluid valve close-off ratings and spring ranges operate at maximum flows and maximum available pump heads scheduled without leakage.
 - 3. Screwed ends except 2-1/2-inch and larger valves with flanged ends.
 - 4. Motorized Control Valves (Pressure Independent Control Valves):

- a. Description: Valve consists of pressure compensating cartridge, actuated ball or Y pattern globe valve, and multiple pressure/temperature test ports in a single valve housing.
 - b. Construction: Rated for no less than 125 PSI and 250 degrees F. 2-inch and Smaller: brass with threaded connections. 2-1/2-inch and larger: cast iron with flanged connections.
 - c. Performance: Flow rate controlled linearly to within 5 percent of target flow rate, for any actuator position (0 to 100 percent), over an operating differential pressure range of 6 to 50 PSI across the valve. Provide valve with integral test ports to verify pressure differential.
 - d. Manufacturers: Belimo, Danfoss, Flow Control Industries, Griswold, Tour and Andersson, or approved equivalent.
- 5. Fluid three-way valves globe valves with linear plug with composition disc for tight shutoff.
 - 6. Pressure drop equal to twice pressure drop through heat exchanger (load), 50 percent of pressure difference between supply and return mains, or 5 PSI, whichever is greater, except two-position valves to be line size.
 - 7. Bubble-tight line size butterfly valves acceptable on 2-1/2-inch lines and above for two-position action only; cast iron body; aluminum bronze disc; EPDM seat, 200 PSI wg
- G. Electric Damper/Valve Actuators:
- 1. Provide mechanical or electronic stall protection for each actuator.
 - 2. Where indicated provide internal mechanical, spring-return mechanism or provide uninterruptible power supply (UPS). Non-spring-return actuators have external manual gear release to position damper/valve when actuator is not powered.
 - 3. Proportional actuators accepts 0 to 10 VDC or 0 to 20 mA control signal and provide 2 to 10 VDC or 4 to 20 mA operating range.
 - 4. Actuator sized for torque required plus 25 percent; UL or CSA listed; electronic current overload protection.
 - 5. VAV Actuators: Actuators proportional 24 VAC actuators using a 4 to 20 mA range of control signals; stops automatically at end of travel; include permanently lubricated gear train.
- H. Air Flow Meters:
- 1. Fan Inlet Type: Self-supporting aluminum traverse probes housing thermal dispersion sensors. Probe spacing and sensor quantity as recommended by manufacturer. Provide factory calibrated electronic flow transmitter with CFM readout display and capability of providing 4 to 20 milliamp output for interface with direct digital controls. Ebtron GTx116-PC.
 - 2. Fan Inlet Type: Self-supporting traverse probe type velocity pressure averaging station; stainless steel construction for exhaust fans; aluminum construction for air handler units. Provide factory calibrated electronic flow transmitter; CFM readout display; capable of providing 4 to 20 milliamp output. Air Monitor Volu-probe/FI; Paragon; Accutrol.
 - 3. Duct Mounted Air Flow Station: Self-supporting aluminum alloy tube with stainless steel mounting brackets. Probe and sensor density quantity as recommended by manufacturer. Sensor use thermal dispersion technology with two "bead in glass," hermetically sealed thermistor probes at each measuring point. Provide electronic flow transmitter with CFM readout display and capable of 4-20 mA output signal. Ebtron GTA116-PC.
- I. Water Flow Meter:
- 1. Provide a Turbine Flow Meter (reference Section 23 05 19) complete with installation hardware necessary to enable insertion and removal of the meter without system shutdown. The flow meter hand-insertable up to 400 PSI. The flow meter to have two contra-rotating axial turbines, with electronic impedance-based sensing and an averaging circuit to reduce measurement errors due to swirl and flow profile distortion. Wetted metal components nickel-plated brass. Provide 316L SS construction for hot water applications operating over 250 degrees F, and for any application in non-metallic pipe. The maximum operating temperature 280 degrees F, 300 degrees F peak. Each flow meter individually

wet-calibrated against a primary volumetric standard that is accurate to within 0.1 percent and traceable to NIST*. Manufacturer's certificate of calibration provided with each flow meter. Accuracy within plus or minus 0.5 percent of rate at the calibrated velocity, within plus or minus 1 percent of rate over a 10:1 turndown (3.0 to 30 ft/s) and within plus or minus 2 percent of rate over a 50:1 turndown (from 0.4 to 20 ft/s). The flow meter to include integral analog output(s), 4-20 mA, 0-10V, or 0-5V. Bi-directional meters to include an isolated contact closure output for direction. Flow meter covered by the manufacturer's two year warranty.

2. Retractable insertion vortex flow meter; accuracy plus 1.0 percent of full scale with 30 to 1 turndown capability; flow range 0.5 to 15 fps; analog output; 400 PSI operating pressure with 400 PSI ball valve; stainless steel shedder bar; rate/total display. Hydro-Flow (Emco) Model 3100.
- J. Wall Mounted Space Carbon Dioxide Sensor:
1. Sensor to employ non-dispersive infrared technology. (N.D.I.R.)
 2. Sensor Repeatability: Plus or minus 20 ppm. 0-2000.
 3. Sensor Accuracy: Less than or equal to 75 ppm over 0-1500 ppm range.
 4. Sensor Response Time: Less than 1 minute.
 5. Sensor to employ reference channel design for long-term stability.
 6. Sensor to have field selectable 0-10VDC, or 4-20mA outputs.
 7. Sensor power requirement less than 3W.
 8. Sensor Input Voltage: 20 to 30VAC/DC.
 9. Sensor Operating Temperature Range: 0 degrees C to 50 degrees C.
 10. Sensor to have models for wall mounting or duct mounting.
 11. Sensor to provide at least a 1-year factory warranty from date of purchase.
 12. Sensor to match cover in color and look to temperature sensor.
 13. Sensor to have display.
 14. Manufacturers:
 - a. Telaire
 - b. Vaisala
 - c. Veris
- K. Paddle Type Flow Switches: Paddle type switches (water service only) UL listed, SPDT snap-acting with pilot duty rating (125 VA minimum) and have adjustable sensitivity with NEMA 1 enclosure.
- L. Relays:
1. Control relays UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage to be suitable for application.
 2. Time delay relays UL listed solid-state plug-in type with adjustable time delay. Delay adjustable plus or minus 200 percent (minimum) from setpoint or as indicated. Contact rating, configuration, and coil voltage to be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- M. Override Timers: Override timers spring-wound line voltage, UL Listed, with contact rating and configuration as required by application. Provide 0-to-6-hour calibrated dial unless otherwise specified. Timer suitable for flush mounting on control panel face and located on local control panels or where shown.
- N. Current Transmitters:
1. AC current transmitters are self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4 to 20 mA two-wire output. Unit range compatible with actual applied span of current value, with internal zero and span adjustment and plus or minus 1 percent full-scale accuracy at 500 ohm maximum burden.
 2. Transmitter meets or exceeds ANSI/ISA S50.1 requirements and UL/CSA recognized.
 3. Unit split-core type for clamp-on installation on existing wiring.

- O. Current Transformers: AC current transformers UL/CSA recognized and completely encased (except for terminals) in approved plastic material; plus or minus 1 percent accuracy at 5 A full-scale.
- P. Voltage Transmitters: AC voltage; self-powered single-loop (two-wire) type; 4 to 20 mA output with zero and span adjustment; UL/CSA recognized at 600 VAC rating and meet or exceed ANSI/ISA S50.1. Ranges include 100 to 130 VAC, 200 to 250 VAC, 250 to 330 VAC, and 400 to 600 VAC full-scale, adjustable, with plus or minus 1 percent full-scale accuracy with 500 ohm maximum burden.
- Q. Voltage Transformers: AC voltage transformers UL/CSA recognized, 600 VAC rated; built-in fuse protection; suitable for ambient temperatures of 40 degrees F to 130 degrees F; plus or minus 0.5 percent accuracy at 24 VAC and a 5 VA load.
- R. Power Monitors: Selectable rate pulse output for kWh reading; 4-20 mA output for kW reading; N.O. alarm contact; ability to operate with 5.0 amp current inputs or 0-0.33 volt inputs; plus 1.0 percent full-scale true RMS power accuracy; plus 0.5 Hz, voltage input range 120-600 V, and auto range select; NEMA 1 enclosure. Current transformers having a 0.5 percent FS accuracy, 600 VAC isolation voltage with 0-0.33 V output. If 0-5 A current transformers are provided, a three-phase disconnect/shorting switch assembly is required.
- S. Overflow Switch: Insertion flow sensor, brass, impeller flow design with analog transmitter unit. Data Industrial Model 220BR.
- T. Ultrasonic Level Transmitter: Non-contact measuring device for liquid level; distance ranges from 4-feet to 32-feet; fail-safe intelligence with diagnostic feedback for troubleshooting; automatic temperature compensation; 24VDC; accuracy plus 0.15 percent of span in air. Kele LU Series.
- U. Emergency Stop Switch: Red, mushroom type, pull out to operate.
- V. End Switches: Turret head Type SPDT. Schneider Electric/Square D Class 9007, Type C54B2, or approved equivalent.
- W. Water Detector: Cast aluminum enclosure with adjustable legs; gold plated probes for water detection; LED for water detection; SPDT alarm contacts; 24 VAC/VDC. Kele WD-1B, or approved equivalent.
- X. Tape Style Water Detector: Adhesive sensor tape with copper fiber electrodes and netted cover; tape integrity self-check feature; 24 VAC/VDC. Manufacturer: Kele WD-2-T.
- Y. Spot Leak Water Detector: Polymer coated sensing probes; adjustable height; 24 VAC/VDC. Manufacturer: Kele SD-R01, or approved equivalent.
- Z. Condensation Sensor:
 - 1. Passive condensation sensor which will reliably and instantly indicate that condensation is occurring.
 - 2. Sensor to be able to indicate condensation prior to the condensation being visually perceptible and to last as long as any trace of condensation remains on the surface.
 - 3. Manufactured specifically for radiant cooling applications.
 - 4. Not dependent on dew point, humidity, or temperature determinations.
 - 5. Specifications (Based on Condenser):
 - a. Mounting:
 - 1) The Model C condenser is mounted via its #8-32 x 3/8-inch non-metallic stud, nut and washer.
 - 2) A Pipe Adapter (Model PA-3) is available for mounting any condenser to a 1/8-inch to 3-inch OD pipe.
 - b. Dimensions: Model C - Nom. 1.1-inch square footprint X 0.8-inch H from the mounting surface.
 - c. Connection: Its 3 foot long cable is terminated in a MONO audio phone plug (1/8-inch / 3.5 mm for the Model C). Provide extensions to suit field conditions.
 - d. Operating Temperatures: 5 to 70 degrees C.

- e. Humidity: Not a factor.
 - f. Contaminants: Inert to materials other than plastic solvents. If it becomes contaminated with dust or other debris, typically, it is easily cleaned by flushing it with alcohol to restore it to service. Require no calibration.
 - g. Provide circuit module to provide binary input to the EMS/BAS with a "SENSOR FAULT."
6. Manufacturers:
- a. Model CG-ICM, no known equal.
 - b. Or approved equivalent.
- AA. Rain Sensor:
1. Sensor is to be used to detect the onset of rainfall. A gold plated grid sensor activates the circuit when water is deposited onto the grid. The presence of water activates an internal relay that may be used in a Building Automation System.
 2. An internal heater constantly dries the grid to prevent relay activation during times of dew, fog, or light moisture that is not actual precipitation. During periods of normal precipitation the heater is unable to dry the grid and the relay is activated. The heater power may be disconnected allowing the detector to be operated as a leaf wetness sensor.
 3. The solid state electronics are mounted in a sealed weatherproof enclosure. The precipitation detector may be tilted to allow water to drain off. A mounting bracket is provided with the sensor to allow mounting onto a 1-inch pipe by a U-bolt. The wind screen must be used to prevent premature drying of the grid during precipitation events accompanied by high winds.
 4. The unit requires plus 12 Vdc power for operation. A 115 Vac power adapter is provided with each unit. Power adapters for voltages other than 115 Vac are available upon request.
 5. Specifications:
 - a. Sensor: Gold plated grid 4-inch diameter.
 - b. Output: Relay (0.5 amps).
 - c. Heater: Resistive element.
 - d. Power: 12 Vdc (235 mA max.) 115 Vac 60 Hz adapter supplied.
 - e. Size: Overall 4-inch diameter x 2-inch high.
 - f. Weight/Shipping: 4 lbs/5 lbs (1.8 Kg/2.3 Kg).
 6. Manufacturers:
 - a. NovaLynx Model 260-2590 Precipitation Detector
 - b. Or approved equivalent.

2.14 WIRING AND RACEWAYS

- A. General: Provide copper wiring, plenum cable, and raceways as specified in applicable Sections of Division 26, Electrical.
- B. Insulated wire to be copper conductors, UL labeled for 90 degrees C minimum service.
- C. Run control wiring as follows:
 1. Mechanical Rooms: In conduit.
 2. Exposed in Building Spaces: In conduit.
 3. Concealed in Building Walls and Ceilings: Plenum rated cable.
 4. Concealed in Building Ceilings: Plenum rated cable in cable tray.
- D. Field and Subfield Panels: Voltage in panels not-to-exceed 120 volts.
- E. Motor Control Centers: Responsibility for correct voltage of holding coils and starter wiring in pre-wired motor control centers interfacing with automatic controls is included hereunder.
- F. Wiring for BAS systems communications buses two conductor minimum 18 gauge foil-shielded, stranded twisted pair cable rated at 300 VDC or more than 80 degrees C.

2.15 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)

- A. See Division 28 for Products.

PART 3 - EXECUTION

3.01 DEMOLITION

- A. Terminal Devices: Remove terminal sensors, actuators and controls as indicated on drawings and as required to accommodate scope of mechanical work shown on drawings and described in specifications. Remove pneumatic piping and cap with hardware as appropriate. Remove wiring and conduit associated with devices. Do not leave any unused abandoned piping or wiring in space.
- B. Graphics and Programming: Remove symbols from control system graphics associated with deleted terminal elements. Modify programming code to delete alarms, control loops, etc., associated with deleted terminal devices.

3.02 EXAMINATION

- A. Prior to starting work, carefully inspect installed work of other trades and verify that such work is complete to the point where work of this Section may properly commence.
- B. Notify the Owner's Authorized Representative in writing of conditions detrimental to the proper and timely completion of the work.
- C. Do not begin work until unsatisfactory conditions are resolved.

3.03 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Testing completed before Owner's Authorized Representative is notified of system demonstration.
- B. Calibrate and prepare for service of instruments, controls, and accessory equipment furnished under this specification.
- C. Verify that control wiring is properly connected and free of shorts and ground faults.
- D. Enable control systems and verify calibration and operation of input and output devices.
- E. Verify that system operation adheres to sequences of operation.
- F. Commissioning and Verification: In addition to commissioning requirements specified elsewhere, provide the following commissioning on the HVAC instrumentation and controls system:
 - 1. Control systems completely commissioned to ensure aspects of the system are operating as intended and at optimum tuning.
 - 2. Wiring connections verified and traced from field device to panel to ensure proper connections.
 - 3. Measured values verified by a hand held calibrated device to validate that value indicated by the control system is in fact the actual measured value.
 - 4. Loops properly tuned to obtain the desired control value. Each loop to be "upset" and put back in control to demonstrate its ability to stabilize quickly.
 - 5. Provide a final point-by-point report submitted that indicates the date of each verification, the results, and initialed on each page by the person performing the reading.

3.04 ACCEPTANCE TESTING AND TRAINING

- A. Site Testing:
 - 1. Contractor provides personnel, equipment, instrumentation, and supplies necessary to perform testing. Owner or Owner's Authorized Representative will witness and sign off on acceptance testing.
 - 2. Contractor demonstrates compliance of completed control system with Contract Documents. Using approved test plan, physical and functional requirements of project demonstrated.
- B. Training:
 - 1. General: Contractor conducts training courses for up to three other designated personnel in operation and maintenance of system. Training manuals provided for each trainee, with two additional copies provided for archival at project site. Manuals include detailed

description of subject matter for each lesson. Copies of audiovisuals delivered to Owner. Training day is defined as 8 hours of classroom instruction, including two 15-minute breaks and excluding lunch time, Monday through Friday, during normal first shift in effect at training facility. Notification of any planned training given to Owner's Authorized Representative at least 15 days prior to training.

2. Operator's Training I: First course taught at supplier's facility for period of one training day. Upon completion, each student should be able to perform elementary operations with guidance and describe general hardware architecture and functionality of system.
3. Operator's Training II: Second course taught at project site for a period of one training day after completion of contractor's field testing. Course includes instruction on specific hardware configuration of installed system and specific instructions for operating installed system. Upon completion, each student should be able to start system, operate the system, recover system after failure, and describe specific hardware architecture and operation of system.
4. Operator's Training III: Third course taught at project site for period of one training day no later than six months after completion of the acceptance test. Course will be structured to address specific topics that students need to discuss and to answer questions concerning operation of system. Upon completion, students should be fully proficient in system operation and have no unanswered questions regarding operation of installed system.

3.05 COMMUNICATION WIRING

- A. Follow manufacturer's installation recommendations for communication cabling.
- B. Verify integrity of network following cable installation.
- C. Communication wiring unspliced length when that length is commercially available; labeled to indicate origination and destination data.
- D. Grounding of coaxial cable in accordance with NEC regulations article on "Communications Circuits, Cable, and Protector Grounding."

3.06 WIRING AND RACEWAYS

- A. Provide electrical wiring required to control systems specified in this Section. Control and interlock wiring complies with national, state and local electrical codes and Division 26, Electrical of this specification.
- B. Power wiring required for building control panel(s) to be dedicated circuit(s).
- C. Verify location of operator work station with Owner prior to installation.
- D. NEC Class 1 (line voltage) wiring UL Listed in approved raceway according to NEC and Division 26, Electrical requirements.
- E. Low-voltage wiring meets NEC Class 2 requirements. (Low-voltage power circuits subfused when required to meet Class 2 current limit.)
- F. Where NEC Class 2 (current-limited) wires are in concealed and accessible locations, including ceiling return air plenums, approved cables not in raceway may be used provided that cables are UL listed for intended application.
- G. Do not install Class 2 wiring in raceway containing Class 1 wiring. Boxes and panels containing high-voltage wiring and equipment may not be used for low-voltage wiring except for purpose of interfacing (e.g., relays and transformers).
- H. Where Class 2 wiring is run exposed, wiring run parallel along surface or perpendicular to it and tied at 10 foot intervals.
- I. Where plenum cables are used without raceway, support from structural members. Do not support cables with ductwork, electrical raceways, piping, or ceiling suspension systems.
- J. Make wire-to-device connections at terminal block or terminal strip. Make wire-to-wire connections at terminal block.

- K. Maximum allowable voltage for control wiring 24 V. If only higher voltages are available, provide step-down transformers.
- L. Wiring installed as continuous lengths, with no splices permitted between termination points.
- M. Install plenum wiring in sleeves where it passes through walls and floors. Maintain fire rating at penetrations.
- N. Include one pull string in each raceway 1-inch or larger.
- O. Control and status relays are to be located in designated enclosures. Enclosures include packaged equipment control panels unless they also contain Class 1 starters.
- P. Install raceway to maintain a minimum clearance of 6-inches from high-temperature equipment (e.g., steam pipes or flues).
- Q. Secure raceways with raceway clamps fastened to structure and spaced according to code requirements. Raceways and pull boxes may not be hung on flexible duct strap or tie rods. Raceways may not be run on or attached to ductwork.
- R. Install insulated bushings on raceway ends and openings to enclosures. Seal top end of vertical raceways.
- S. Flexible metal raceways and liquid-tight, flexible metal raceways not-to-exceed 3-feet in length and be supported at each end. In areas exposed to moisture, including chiller and boiler rooms, liquid-tight, flexible metal raceways to be used.
- T. Raceway must be rigidly installed, adequately supported, properly reamed at both ends, and left clean and free of obstructions. Raceway sections joined with couplings. Terminations made with fittings at boxes.
- U. Input and output terminations to be labeled at the controller to identify if they are AI, DI, AO, DO, and function (i.e. pump start, OM Sensor).

3.07 INSTALLATION OF AUXILIARY CONTROL DEVICES

- A. General:
 - 1. Install sensors and thermostats in accordance with manufacturer's recommendations.
 - 2. Room sensors and thermostats installed at 48-inches AFF to midline of sensor on concealed junction boxes properly supported by wall framing at the locations shown on the Drawings.
 - 3. Low-limit sensors used in mixing plenums installed in a serpentine manner horizontally across duct.
 - 4. Pipe-mounted temperature sensors installed in wells with heat-conducting fluid in thermal wells.
 - 5. Install outdoor air temperature sensors on north facing wall or screen, complete with sun shield at designated location.
- B. Flow Switch: Use correct paddle for pipe diameter. Adjust flow switch in accordance with manufacturer's instructions.
- C. Actuators:
 - 1. General:
 - a. Mount and link control damper actuators according to manufacturer's instructions.
 - b. Check operation of damper/actuator combination to confirm that actuator modulates damper smoothly throughout stroke to both open and closed positions.
 - 2. Actuator Mounting for Damper and Valve Arrangements to Comply with the Following:
 - a. Damper Actuators: Do not install in the air stream.
 - b. Use a weather proof enclosure (clear and see through) if actuators are located outside.
 - c. Damper or valve actuator ambient temperature not-to-exceed 122 degrees F through any combination of medium temperature or surrounding air. Provide appropriate air gaps, thermal isolation washers or spacers, standoff legs, or insulation as necessary. Mount per manufacturer's recommendations.

- d. Actuator cords or conduit to incorporate a drip leg if condensation is possible. Do not allow water to contact actuator or internal parts. Location of conduits in temperatures dropping below dew point to be avoided to prevent water from condensing in conduit and running into actuator.
 - e. Damper mounting arrangements to comply with the following:
 - 1) Furnish and install damper channel supports and sheet metal collars.
 - 2) Jack shafting of damper sections not allowed.
 - 3) Multi-section dampers arranged so that each damper section operates individually. Provide one electronic actuator direct shaft mounted per section.
 - f. Size damper sections based on actuator manufacturers specific recommendations for face velocity, differential pressure and damper type. In general: Damper section not-to-exceed 24 ft-sq. with face velocity 1500 FPM.
 - g. Multiple section dampers of two or more arranged to allow actuators to be direct shaft mounted on the outside of the duct.
 - h. Multiple section dampers of three or more sections wide arranged with a 3-sided vertical channel (8-inch wide by 6-inch deep) within the duct or fan housing and between adjacent damper sections. Vertical channel anchored at the top and bottom to the fan housing or building structure for support. Connect sides of each damper frame to the channels. Holes in the channel to allow damper drive blade shafts to pass through channel for direct shaft mounting of actuators. Face open side of channel downstream of the airflow, except for exhaust air dampers.
 - i. Multiple section dampers to be mounted flush within a wall or housing opening to receive either vertical channel supports as described above or sheet metal stand out collars. Sheet metal collars (12-inch minimum) to bring each damper section out of the wall to allow direct shaft mounting of the actuator on the side of the collar.
- D. Control Valve:
- 1. Valves installed in accordance with manufacturer's recommendations.
 - 2. Slip-stem control valves installed so that stem position is not more than 60 degrees from vertical up position. Ball type control valves installed with stem in horizontal position.
 - 3. Control valves accessible and serviceable.
 - 4. Install isolation valves so that control valve may be serviced without draining supply/return side piping system. Install unions at connections to screw-type control valves.
 - 5. Valve Sizing for Water Coil:
 - a. On/Off Control Valves: Line size.
 - b. Modulating control valve body size may be reduced, at most, two pipe sizes from the line size or not less than 1/2 the pipe size. BAS contractor to size water coil control valves for the application as follows:
 - 1) Booster-heat valves sized not-to-exceed 4-9 PSI differential pressure. Size valve for 50 percent valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 2) Primary valves sized not-to-exceed 5-15 PSI differential pressure. Size valve for 50 percent valve authority. Valve design pressure drop is equal to the sum of coil drop plus the balance valve drop.
 - 3) Butterfly valves sized for modulating service at 60 to 70 degree rotation. Design velocity 12-feet per second or less when used with standard EPDM seats.
 - c. Valve Mounting Arrangements to Comply with the Following:
 - 1) Provide unions on ports of two-way and three-way valves.
 - 2) Install three-way equal percentage Characterized Control valves in a mixing configuration with the "A" port piped to the coil.
 - 3) Install 2-1/2-inch and above, three-way globe valves, as manufactured for mixing or diverting service to the coil.
- E. Control Damper:

1. Dampers installed in accordance with manufacturer's instructions. Unless specifically designed for vertical blade application, dampers must be mounted with blade axis horizontal.
 2. After installation of low-leakage dampers with seals, caulk between frame and duct or opening to prevent leakage around perimeter of damper.
- F. Air Flow Station: Install where indicated in ductwork and/or equipment with manufacturer's recommended straight ductwork upstream and downstream of air flow station or as shown on drawings, whichever is greater. Where equipment manufacturer's standard airflow measuring station cannot read airflows at required design velocities, provide appropriate air flow measuring station to provide accurate reading throughout system design operations range.

3.08 WATER DETECTOR

- A. Mount by applying a silicone adhesive to the mounting feet. For more permanent installations, fasten the sensor using the 0.19-inch holes provided in the mounting feet with #6 or #8 screws.
- B. Mount adjacent to area to be protected. Unroll the sensor tape, remove vinyl release layer from the back, and hand press onto surface that is dry and free of debris and dust.
 1. Note 1: Once the sensor is activated (wet), the contacts will remain in alarm until the netted cover is completely dry.
 2. Note 2: To convert the tape integrity check relay to a second alarm relay, remove the jumper in the lower right corner of the circuit board. If the sensing tape is not used, install the jumper labeled "NO TBL CHK."
- C. Mount by screwing or gluing to the floor or baseboard.

3.09 SMOKE DETECTION (FOR PROJECTS WITH A FIRE ALARM SYSTEM)

- A. Smoke detector furnished and powered/wired under Division 28, Electronic Safety and Security. Coordinate with fire alarm equipment supplier. Installation of duct smoke detector housing and sampling tube under Division 23, HVAC.
- B. Install smoke detectors in return air systems greater than 2000 CFM.
- C. Install smoke detectors at each story prior to connection to return air riser in systems greater than 15,000 CFM and serving more than one story.

3.10 SEQUENCES OF OPERATION AND POINTS LISTS

- A. Where local energy code dictates certain sequences (such as night setback, night flush, pressure and temperature reset, terminal unit sequences, etc.), the sequences are not necessarily repeated in the documents. It is not the intent of this specification or documentation to reiterate the energy code. Provide energy code mandated sequences and document in sequence of operations submittals at no additional cost to the Owner. Provide required points to achieve the appropriate sequences.
- B. See control diagrams and sequences on drawings.
- C. Variable Frequency Drives: For a VFD dependent on an external input for its output setting (e.g., the VFD gets "Frequency" as an input), loss of that external input to result in the VFD holding its last value. If the VFD is running its own PID loop and the external input to the VFD is a setpoint (e.g. duct static pressure setpoint), the VFD to hold the last setpoint. If the VFD loses its process variable (e.g. duct static pressure), the VFD to go to its minimum speed setting.
- D. Except as specified otherwise, throttling ranges, proportional bands, and cycle differentials to be centered on the associated setpoint. Modulating feedback control loops to include the capability of having proportional, integral, and derivative action. Unless the loop is specified "proportional only" or "P+I", Contractor to apply appropriate elements of integral and derivative gain to each control loop to result in stable operation, minimum settling time and maintain the primary variable within the specified maximum allowable variance.
- E. Provide a real time clock and schedule controller with sufficient scheduling capability to schedule required controllers and sequences. Schedule functionality may reside in a controller.

If a controller is used, document scheduling functionality including names and types on controller points list submittal. Set up initial schedules in coordination with Owner.

- F. Scheduling Terminology: When air handlers are scheduled throughout the day, the following defines the terminology used:
1. Occupied Period: Period of time when the building is in use and occupied. Confirm schedule with Owner. Exclude all national holidays. Generally systems will be fully operational throughout this period and ventilation air to be continuously introduced. Space temperature setpoints will generally be in the “normal” range of 68 degrees to 78 degrees F.
 2. Unoccupied period: Period of time when the building or zone is not in use and unoccupied. Ventilation air not to be introduced.
 3. Preoccupancy Period: Time prior to the Occupied period when the systems are returning the space temperatures from setback to “normal” or occupied setpoints (warm-up and cool-down). Ventilation air shall not be introduced unless outside air conditions permit free-cooling or to support a pre-occupancy purge sequence. Time period to be determined by an optimum start strategy unless otherwise specified.
 4. Setback Period: Setback will typically start with the end of the occupied period and end with the start of the preoccupancy period, however it shall be provided with its own schedule. Generally systems will be off except to maintain a “setback” temperature, economization may be enabled to maintain “setback” cooling setpoint when applicable.
- G. Where any sequence or occupancy schedule calls for more than one motorized unit to start simultaneously, the BAS start commands to be staggered by 5 second (adj.) intervals to minimize inrush current.
- H. Wherever a value is indicated as adjustable (adj.), it shall be modifiable, with the proper password level. For these points, it is unacceptable to have to modify programming statements to change the setpoint.
- I. When a power failure is detected in any phase, the BAS start commands to be retracted immediately from electrically powered units served by the failed power source. If the associated controller is powered by normal or emergency power, it may monitor its own power source as an indication of power status. If the controller is powered by uninterruptible power supply (UPS), or if it is not capable of monitoring its own power for use in sequences, provide at least one voltage monitor (three phase when applicable) per building. When the BAS detects that normal or emergency power has been restored, all equipment for which the BAS start command had been retracted to be automatically restarted in an orderly manner on staggered 5 second intervals to minimize inrush current.
- J. Where reset action is specified in a sequence of operation, but a reset schedule is not indicated on the drawings, employ one of the following methods:
1. Determine a fixed reset schedule to result in stable operation and maintain the primary variable within the specified maximum allowable variance.
 2. Use a floating reset algorithm which increments the secondary variable setpoint (setpoint of control loop being reset) on a periodic basis to maintain primary variable setpoint. The recalculation time and reset increment to be chosen to maintain the primary variable within the specified maximum allowable variance.
 3. Primary variable to control the devices directly using a PID feedback control loop without resetting the secondary variable. However, the control devices to still modulate as necessary to maintain upper and lower limits on the secondary variable. Proportional band, integral gain, and derivative term to be selected to maintain the primary variable within the specified maximum allowable tolerance while minimizing overshoot and settling time. Gain prior approval for implementing this method of reset.
- K. Where a supply air temperature or duct pressure setpoint is specified to be reset by the space temperature of the zones calling for the most cooling/heating, employ the following method:
1. Use a floating reset algorithm which increments the secondary variable (e.g., supply air temperature or duct pressure) setpoint on a periodic basis to maintain primary variable

(e.g., space temperature) setpoint. The reset increment to be determined by the quantity of “need heat” or “need cool” requests from individual SCU's. A SCU's “need heat” virtual point to activate whenever the zone's space temperature falls below the currently applicable (occupied or unoccupied) heating setpoint throttling range. A SCU's “need cool” virtual point to activate whenever the zone's space temperature rises above the currently applicable (occupied, unoccupied, or economy) cooling setpoint throttling range. The recalculation time and reset increment to be chosen to maintain the primary variable within the specified maximum allowable variance while minimizing overshoot and settling time. Reset range maximum and minimum values to limit the setpoint range.

- L. Where a supply air temperature, duct pressure, or differential water pressure setpoint is specified to be reset by valve or damper position of the zone or zones calling for the most cooling/heating, the following method to be employed:
 - 1. A floating reset algorithm to be used which increments the secondary variable (e.g., supply air temperature, pipe or duct pressure) setpoint on a periodic basis to maintain primary variable (e.g., cooling valve, heating valve, damper position) setpoint of 85 percent open. The reset increment to be calculated based on the average position of the quantity of the worst (most open valve/damper) zone(s) as specified. The recalculation time, reset increment and control device position influence to be chosen to maintain the primal variable within the specified maximum allowable variance while overshoot and settling time. The BAS analog output value to be acceptable as indicating the position of the control device.
 - 2. Alternatively to continuously calculating the average of the quantity of worst valve/damper positions, a method similar to the one described above may be employed whereby the “need heat” or “need cool” virtual point to increment by one unit each time a zone's valve/damper position rises to greater than 95 percent. The quantity of “need heat” or “need cool” points to then be the basis for reset.
- M. Where “prove operation” of a device (generally controlled by a digital output) is indicated in the sequence, it shall require that the BAS, after an adjustable time delay after the device is commanded to operate (feedback delay), confirm that the device is operational via the status input. If the status point does not confirm operation after the time delay or anytime thereafter for an adjustable time delay (debounce delay) while the device is commanded to run, an alarm to be enunciated audibly. Upon failure, run command to be removed and the device to be locked out until the alarm is manually acknowledged unless specified otherwise.
- N. BAS to provide for adjustable maximum rates of change for increasing and decreasing output from the following analog output points:
 - 1. Speed control of variable speed drives
 - 2. Control Reset Loop
 - 3. Valve Travel Limit
- O. Wherever a value is indicated to be dependent on another value (i.e., setpoint plus 5 degrees F) BAS to use that equation to determine the value. Simply providing a virtual point that the operator must set is unacceptable. In this case three virtual points to be provided. One to store the parameter (5 degrees F), one to store the setpoint, and one to store the value which is the result of the equation.
- P. Trend points as identified in the points list. Trends to be grouped system specific and setup in two-axis (x,y) graphical format that display object values relative to time. Setup trends to record data in 5 minute increments.

END OF SECTION

SECTION 23 21 13 - HVAC PIPING

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Heating Water Piping, Above Ground
 - 2. Chilled Water Piping, Above Grade
 - 3. Equipment Drains and Overflows

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Welding Certificates: Copies of certificates for welding procedures and personnel.
 - 2. Field Test Reports: Written reports of tests specified in Part 3 of this Section. Include the following:
 - a. Test procedures used.
 - b. Test results that comply with requirements.
 - c. Failed test results and corrective action taken to achieve requirements.
 - 3. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at project site.
 - 4. Buried piping manufacturer to submit thrust block (chilled water) and anchor plate (heating hot water) layout and details including anchorage and seismic calculations.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Installer Qualifications: Company specializing in performing work of the type specified in this Section, with documented experience.
 - 2. Welder Qualifications: Certify in accordance with ASME (BPV IX).
 - 3. ASME Compliance: Comply with ASME B31.9 "Building Services Piping" for materials, products, and installation. Provide safety valves and pressure vessels with the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 01.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements, General Requirements.

PART 2 - PRODUCTS

2.01 HEATING WATER PIPING, ABOVE GROUND

- A. Steel Pipe: ASTM A53/A 53M, Schedule 40, black, Type E (electric resistance welded), Grade B.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
 - 2. 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:
 - a. Material Group: 1.1.

- b. End Connections: Butt welding.
 - c. Facings: Raised face.
- 3. Joints: Threaded or AWS D1.1 welded.
- B. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - 2. Joints: Solder, lead free ASTM B32, HB alloy (95-5 tin antimony), or tin and silver.
 - 3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inches or larger or piping routed over food preparation centers, food serving facilities, food storage areas, computer rooms, telecommunications rooms, and electrical rooms.

2.02 CHILLED WATER PIPING, ABOVE GRADE

- A. Manufacturers - Grooved Mechanical Joint Fittings and Couplings:
 - 1. Central Sprinkler Company; Central Grooved Piping Products
 - 2. Anvil International
 - 3. Shurjoint Piping Products
 - 4. Or approved equivalent.
- B. Steel Pipe: ASTM A 53/A 53M, Schedule 40, black, Type E (electric resistance welded), Grade B.
 - 1. Fittings: ASME B16.3, malleable iron or ASTM A 234/A 234M, wrought steel welding type.
 - 2. 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:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
 - 3. Joints: Threaded or AWS D1.1 welded.
- C. Grooved Mechanical Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47 (ASTM A47M), Grade 32510 malleable iron; ASTM A53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
 - 1. Grooved Mechanical-Joint Couplings: Ductile or malleable iron housing and synthetic rubber gasket of central cavity pressure-responsive design for operating temperature range from -30 degrees F to 230 degrees F. Gasket material as recommended by manufacturer for design conditions.
- D. Steel Pipe Sizes 12-inch and Over: ASTM A 53/A 53M, 0.375-inch wall, black.
 - 1. Fittings: ASTM A 234/A 234M, wrought steel welding type.
 - 2. 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:
 - a. Material Group: 1.1.
 - b. End Connections: Butt welding.
 - c. Facings: Raised face.
 - 3. Joints: Welded in accordance with AWS D1.1.
 - 4. Grooved Mechanical Joint Fittings: ASTM A536, Grade 65-45-12 ductile iron; ASTM A47 (ASTM A47M), Grade 32510 malleable iron; ASTM A53, Type F, E, or S, Grade B fabricated steel; or ASTM A 106, Grade B steel fittings with grooves or shoulders designed to accept grooved end couplings.
 - 5. Grooved Mechanical-Joint Couplings: Ductile or malleable iron housing and synthetic rubber gasket of central cavity pressure-responsive design for operating temperature range from -30 degrees F to 230 degrees F.
- E. Copper Tube: ASTM B 88 (ASTM B 88M), Type L, hard drawn.
 - 1. Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper.
 - 2. Joints: Solder, lead free ASTM B32, HB alloy (95-5 tin antimony), or tin and silver.

3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inches or larger or piping routed over food preparation centers, food serving facilities, food storage areas, computer rooms, telecommunications rooms, or electrical rooms.

2.03 EQUIPMENT DRAINS AND OVERFLOWS

- A. Copper Tube: ASTM B 88 (ASTM B 88M), Type L (B), drawn.
 1. Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 2. Joints: Solder, lead free, ASTM B 32, HB alloy (95-5 tin-antimony), or tin and silver.
 3. Joints: Brazed, AWS A5.8, Classification BAg-1 (silver). Pipes 2-1/2-inch or larger or piping routed over food preparation centers, food serving facilities, food storage areas, computer rooms, telecommunications rooms, and electrical rooms.

END OF SECTION

SECTION 23 21 16 - HYDRONIC PIPING SPECIALTIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Air Vents
 - 2. Pressure Reducing Valves
 - 3. Liquid Flow Switches
 - 4. Instrument Probe Fittings
 - 5. Strainers

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ASME (BPV VIII, 1) - Boiler and Pressure Vessel Code, Section VIII, Division 01 - Rules for Construction of Pressure Vessels; The American Society of Mechanical Engineers.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product Data: Provide product data for manufactured products and assemblies required for this project. Include component sizes, rough-in requirements, service sizes, and finishes. Include product description, model and dimensions.
 - 2. Certificates: Inspection certificates for pressure vessels from Authority Having Jurisdiction (AHJ).
 - 3. Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
 - 4. Project Record Documents: Record actual locations of flow controls.
 - a. Maintenance Data: Include installation instructions, assembly views, lubrication instructions, and replacement parts list.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum three years of documented experience.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Air Vents:
 - 1. Armstrong International, Inc.
 - 2. ITT Bell & Gossett.
 - 3. Taco, Inc.
 - 4. Hoffman
 - 5. Amtrol
 - 6. Metraflex
- B. Pressure Reducing Valves:
 - 1. Armstrong
 - 2. ITT Bell and Gossett
 - 3. Taco, Inc.
 - 4. Amtrol
 - 5. Kunkle
- C. Liquid Flow Switches:
 - 1. McDonnell & Miller
 - 2. Dwyer
 - 3. Or approved equivalent.
- D. Instrument Probe Fittings:
 - 1. Pete's Plug
 - 2. Or approved equivalent.
- E. Strainers:
 - 1. Armstrong International
 - 2. Mueller
 - 3. Keckley
 - 4. Hoffman

2.02 AIR VENTS

- A. Manual Type: Short vertical sections of pipe to form air chamber, with 1/8-inch brass needle valve at top of chamber.
- B. Automatic Float Type: Brass or semi-steel body, copper, polypropylene, or solid non-metallic float, stainless steel valve and valve seat; suitable for system operating temperature and pressure; with isolating valve.

2.03 PRESSURE REDUCING VALVES

- A. Brass body, adjustable range, inlet check valves, removable inlet strainer, noncorrosive valve seat and stem, 3/4-inch size unless otherwise shown, factory set at fill pressure as indicated on drawings.

2.04 LIQUID FLOW SWITCHES

- A. Description: Brass for wetted parts with packless construction, paddle with removable segments for pipe size and flow velocity, vapor proof electrical compartment for switches mounted on cold hydronic piping systems, switches for 115V, 60 Hz, 1-phase with 7.4A rating.

2.05 INSTRUMENT PROBE FITTINGS

- A. Brass or stainless steel body and cap, high pressure rated, valve material neoprene, Nordan or Viton to suit temperature range, 1/4-inch or 1/2-inch NPT tailpiece.

2.06 STRAINERS

- A. Size 2-inches and Under: Screwed brass or iron body for 175 PSI working pressure, Y pattern with 1/16-inch stainless steel perforated screen.

- B. Size 2-1/2-inches and Larger: Flanged or grooved and above: iron body for 175 PSI working pressure, Y pattern with 1/16 stainless steel perforated screen.
- C. Basket Pattern: Flanged iron body for 175 PSI working pressure, basket pattern with 1/8-inch stainless steel perforated screen, clamped or bolted cover.

END OF SECTION

SECTION 23 31 00 - HVAC DUCTS AND CASINGS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Ductwork, Joints and Fittings
 - 2. Insulated Flexible Duct
 - 3. Drain Pans
 - 4. Ductwork Joint Sealers and Sealants

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Section 23 05 29, Hangers and Supports for HVAC Piping, Ductwork and Equipment.
 - 2. Section 23 05 93, Testing, Adjusting, and Balancing for HVAC.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Welding Certificates
 - 2. Field Quality Control Reports

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. NFPA Compliance:
 - a. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
 - b. NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
 - 2. Comply with NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations, Ch. 3, Duct System for range hood ducts, unless otherwise indicated.
 - 3. Comply with SMACNA's HVAC Duct Construction Standards - Metal and Flexible for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated. Provide sheet metal materials free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
 - 4. Provide ductwork pressure testing and leakage testing per Section 23 05 93, Testing, Adjusting and Balancing for HVAC.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 SYSTEM DESCRIPTION

- A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Duct design is generally diagrammatic and is not meant to be scaled. Major changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Ductwork, Joints, and Fittings:
 - 1. Ductmate
 - 2. Lindab Inc
 - 3. Nexus Inc
 - 4. SEMCO
 - 5. United McGill Corporation
 - 6. Ward Industries
- B. Insulated Flexible Duct:
 - 1. ATCO
 - 2. Flexmaster
 - 3. J.P. Lamborn Co.
 - 4. Hart and Cooley
- C. Ductwork Joint Sealers and Sealants
 - 1. Ductmate
 - 2. Durodyne
 - 3. Hardcast
 - 4. United McGill Corporation
 - 5. Vulkem
 - 6. Foster
 - 7. Childer

2.02 DUCTWORK, JOINTS AND FITTINGS

- A. Materials:
 - 1. Galvanized Steel Ducts: Hot-dipped galvanized steel sheet, lock-forming quality, ASTM A 653/A 653M FS Type B, with G90/Z275 coating. Ducts to have mill phosphatized finish for surfaces exposed to view.
 - 2. Aluminum Ducts: ASTM B 209 (ASTM B 209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts with liquid-tight joints when containing condensate vapor or liquids in suspension.
 - 3. Stainless Steel: Fabricated in accordance with ASTM A167 and A480 with liquid-tight joints when containing condensate vapor or liquids in suspension.
- B. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 - 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 - 2. Deflection: Duct systems not-to-exceed deflection limits according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 - 3. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
- C. Formed-On Flanges: construct according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible, Figure 1-4, using corner, bolt, cleat, and gasket details.
 - 1. Duct Size: Maximum 30-inches wide and up to 2-inch wg pressure class.
 - 2. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.
 - 3. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19-inches and larger and 0.0359-inch thick or less, with more than 10 SF of nonbraced panel area unless ducts are lined.

- D. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of material specified in this Section according to SMACNA's HVAC Duct Construction Standards - Metal and Flexible.
 - 1. Ducts up to 20-inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
 - 2. Ducts 21- to 72-inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
 - 3. Ducts Larger than 72-inches in Diameter: Companion angle flanged joints per SMACNA HVAC Duct Construction Standards-Metal and Flexible, Figure 3-2.
 - 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- E. 90-Degree Tees and laterals and Conical Tees: Fabricate to comply with SMACNA's HVAC Duct Construction Standards-Metal and Flexible, with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows to be 1.5 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
 - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's HVAC Duct Construction Standards-Metal and flexible, unless otherwise indicated.
 - 2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg (minus 500 to plus 500 Pa):
 - a. Ducts 3- to 36-inches in Diameter: 0.034-inch .
 - b. Ducts 37- to 50-inches in Diameter: 0.040-inch.
 - c. Ducts 52- to 60-inches in Diameter5: 0.052-inch.
 - d. Ducts 62- to 84-inches in diameter: 0.064-inch.
 - 3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:
 - a. Ducts 3- to 26-inches in Diameter: 0.034-inch.
 - b. Ducts 27- to 50-inches in Diameter: 0.040-inch.
 - c. Ducts 52- to 60-inches in Diameter: 0.052-inch.
 - d. Ducts 62- to 84-inches in Diameter: 0.064-inch.
 - 4. 90-Degree, Two-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
 - 5. Round Elbows
 - a. 8-inches and Less in Diameter: Fabricate die-formed elbows for 45 and 90-degree elbows and pleated elbows for 30, 45, 60 and 90 degrees only. Fabricate nonstandard bend-angle configurations or non-standard diameter elbows with gored construction.
 - b. 9 through 14-inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60 and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
 - c. Larger than 14-inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
 - 6. Die-Formed Elbows for Sizes through 8-inches in Diameter and Pressures 0.040-inch thick with two-piece welded construction.
 - 7. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
 - 8. Pleated Elbows for Sizes through 14-inches in Diameter and Pressures through 10-inch wg (2500 Pa): 0.022-inch.
 - 9. Not acceptable:
 - a. Corrugated or flexible metal duct.
 - b. Adjustable elbows.

2.03 INSULATED FLEXIBLE DUCT

- A. Construction: Standard factory fabricated product. Inner wall: Impervious vinyl or chlorinated polyethylene, permanently bonded to a vinyl or zinc-coated spring steel helix.
- B. Insulation: Fiberglass blanket insulation covered by an outer wall of vinyl or fiberglass-reinforced metalized vapor barrier.
- C. Listing: UL 181 listed Class 1 flexible air duct material. Overall thermal transmission: No more than 0.25 BTU/in or hr/sq. degrees F at 75 degrees F differential, per ASTM C335.
- D. Vapor transmission value no more than 0.10 perm, per ASTM E96
- E. Pressure Rating: 4-inch wg positive pressure and 1-inch wg negative pressure.
- F. Performance Air Friction Correction Factor: 1.3 maximum at 95 percent extension. Working air velocity: Minimum 2000 FPM.
- G. Flame Spread Rating: No more than 25.
- H. Smoke Development Rating: No more than 50 as tested per ASTM E84.
- I. Insertion Loss: Minimum attenuation of 29 DB for 10-foot straight length at 8-inch diameter at 500 Hz.

2.04 DRAIN PANS

- A. Primary Drain Pans: Stainless Steel, Fabricated in accordance with ASTM A167 and A480.
- B. Secondary Drain Pans: Galvanized Steel: Hot-dipped galvanized steel sheet, ASTM A 653/A 653M FS Type B, with G90/Z275 coating.

2.05 DUCTWORK JOINT SEALERS AND SEALANTS

- A. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
- B. Low Emitting Materials Requirement: Adhesives, sealants and sealant primers must comply with South Coast Air Quality Management District (SCAQMD) Rule #1168.
- C. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure and leakage class of ducts.
- D. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.
- E. Water Based Sealant for Brush-On Application: Flexible, adhesive sealant, resistant to UV light, UL-181A, and UL-181-B listed, complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Hardcast Versa-Grip 181; Childers CP-146; Foster 32-19 for SMACNA 1/2, 1, 2, 3, 4, 6, and 10-inch WG duct classes, and SMACNA Seal Class A, B, or C.
- F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- H. Polyurethane Sealant: General-purpose, exterior use, non-brittle sealant for gunned application. Vulkem 616 or equal.

END OF SECTION

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Sheet Metal Materials
 - 2. Backdraft Dampers
 - 3. Dampers
 - 4. Concealed Damper Hardware
 - 5. Access Doors
 - 6. Duct Test Holes
 - 7. Combination Fire and Smoke Dampers
 - 8. Flexible Connectors

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Manufacturer's catalog data and fabrication/installation drawings for each factory fabricated duct accessory. Include leakage, pressure drop and maximum back pressure data.
 - 2. Shop Drawings: Indicate air duct accessories.
 - 3. Manufacturer's installation instructions: Provide instructions for each factory fabricated duct accessory.
 - 4. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. See Division 01, General Requirements, Product Requirements for additional provisions.
 - b. Extra Fusible Links: One of each type and size.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this Section, with minimum five years of documented experience.
 - 2. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.
 - 3. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
 - 4. AMCA 511 - Certified Ratings Program for Air Control Devices.
 - 5. AMCA 611, latest edition - Certified Ratings Program - Product Rating Manual for Airflow Measurement Stations.
 - 6. AMCA 610, latest edition - Laboratory Methods of Testing Airflow Measurement Stations for Performance Rating.
 - 7. CSFM - California State Fire Marshal Listing for Fire Damper and Smoke Damper.
 - 8. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
 - 9. NFPA 92A - Smoke-Control Systems.
 - 10. NFPA 92B - Smoke Control Systems in Atria, Covered Malls and Large Areas.

11. NFPA 101 - Life Safety Code.
12. UL 555 - Standard for Safety; Fire Dampers.
13. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Backdraft Dampers:
 1. Air Balance
 2. Cesco
 3. Greenheck
 4. Nailor
 5. Ruskin
- B. Dampers:
 1. Air Balance
 2. Cesco
 3. Greenheck
 4. Nailor
 5. Ruskin
- C. Concealed Damper Hardware, Cable System:
 1. Young Regulator Company
- D. Access Doors:
 1. Ductmate
 2. Cesco
 3. Ruskin
 4. Nailor
 5. Outdoor Installation: Karp MX insulated exterior access door.
- E. Duct Test Holes:
 1. Ventlok
- F. Combination Fire and Smoke Dampers:
 1. Ruskin
 2. Greenheck
 3. Nailor
 4. Pottorff
- G. Flexible Connectors:
 1. Duro Dyne Corp.
 2. Ventfabrics Inc.
 3. Ductmate Industries
 4. Hardcast

2.02 SHEET METAL MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods, unless otherwise indicated.
- B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M. Galvanizing: 1-1/4 ounces per square foot total both sides; ducts to have mill-phosphatized finish for surfaces exposed to view.
- C. Stainless Steel: ASTM A 480/A 480M.

- D. Aluminum Sheets: ASTM B 209 (ASTM B 209M), alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: ASTM B 221 (ASTM B 221M), alloy 6063, temper T6.
- F. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36-inches or less; 3/8-inch minimum diameter for lengths longer than 36-inches.

2.03 BACKDRAFT DAMPERS

- A. Basis-of-Design: Ruskin CB D6.
- B. Description: Multiple-blade gravity balanced with center pivoted blades with sealed edges, assembled in rattle free manner with 90-degree stop, adjustment device to permit setting for varying differential static pressure.
- C. Frame: 0.125-inch thick 6063-T5 extruded aluminum channel with galvanized steel braces at mitered corners. Provide mounting flange.
- D. Blades: Single piece, overlap frame, parallel action, horizontal orientation, minimum 0.07-inch 6063-T5 extruded aluminum material, maximum 6-inch width.
- E. Bearings: Corrosion-resistant synthetic, formed as single piece with axles.
- F. Blade Seals: Extruded vinyl, mechanically attached to blade edge.
- G. Blade Axles: Corrosion-resistant, synthetic formed as single piece with bearings, locked to blade.
- H. Tie Bars and Brackets: Galvanized steel.
- I. Return Spring: Adjustable tension.
- J. Damper Capacity:
 - 1. Closed Position: Maximum back pressure of 16-inches water gauge.
 - 2. Open Position: Maximum air velocity of 2,500-feet per minute.
- K. Counterbalances: Adjustable zinc plated steel weights mechanically attached to blade. Must be capable of operating over wide range of pressures.
- L. Finish: Mill aluminum.
- M. Temperature Rating: -40 degrees F to 200 degrees F.
- N. Operation of Blade:
 - 1. Start to Open: 0.01-inch wg
 - 2. Fully Open: 0.05-inch.
- O. Pressure Drop: Maximum 0.15-inch wg at 1,500-feet per minute through 24-inch by 24-inch damper.
- P. Factory Sleeve: Minimum 20 gauge thickness, 12-inches in length.
- Q. Screen: At outdoor intake or discharge. 1/4-inch aluminum.

2.04 DAMPERS

- A. Basis-of-Design: Ruskin MD 35.
- B. General Description: 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 Classes of 3-Inch wg (750 Pa) or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.
- C. Rectangular Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design with linkage concealed in frame and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
 - a. Roll-Formed Steel Blades: 16 gauge thick, galvanized sheet steel.
 - b. Aluminum Frames: Hat-shaped, 10 gauge thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 - c. Roll-Formed Aluminum Blades: 10 gauge thick aluminum sheet.
 - d. Extruded-Aluminum Blades: 16 gauge thick extruded aluminum.
 - e. Blade Axles: Minimum 1/2-inch diameter, plated steel, hex shaped, mechanically attached to blade.
 - f. Bearings: Molded synthetic sleeve, turning in extruded hole in frame.
 - g. Tie Bars and Brackets: Galvanized steel.
 - h. Mill galvanized.
 - i. Capacity:
 - 1) Closed Position: Maximum pressure of 3-inches wg.
 - 2) Open Position: Maximum air velocity of 1,500-feet per minute across 24-inch by 24-inch damper.
- D. Round Volume Dampers: Single-blade suitable for horizontal or vertical applications.
 1. Steel Frames: Galvanized, roll formed, minimum of 20 gauge thick with beads at each end.
 2. Blades: Minimum 20 gauge thick, galvanized sheet steel, round, single-piece.
 3. Aluminum Frames: Minimum 10 gauge thick aluminum sheet.
 4. Aluminum Blades: Minimum 10 gauge thick aluminum sheet.
 5. Extruded-Aluminum Blades: Minimum 16 gauge thick extruded aluminum.
 6. Blade Axles: Minimum 3/8-inch square, plated steel, mechanically attached to blade.
 7. Bearings: Molded synthetic sleeve, turning in hole in frame.
 8. Finish: Mill galvanized.
 9. Capacity:
 - a. Closed Position: Maximum pressure of 3-inches wg
 - b. Open Position: Maximum air velocity of 1,500-feet per minute.
 10. Leakage: Maximum 40 cfm at 1-inch wg for 20-inches diameter damper.
 11. Pressure Drop: Maximum 0.02-inch wg at 1,500-feet per minute through 20-inch diameter dampers.
- E. Jackshaft: 1-inch diameter, galvanized-steel pipe rotating within 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 in multiple-damper assembly.
 2. 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 2-inch elevated platform for insulated duct mounting.

2.05 CONCEALED DAMPER HARDWARE

- A. Concealed Damper Hardware: For dampers above non-removable ceilings (gyp, plaster, decorative, etc.) where access panels have not been shown on Architectural drawings or in locations where dampers are more than 2-feet above the ceiling, provide:
 1. Concealed Damper Regulator: Young Regulator Company Model 315 or approved equivalent.
 2. Cable System: Young Regulator Company or approved equivalent.
 3. Controller: Young Regulator Company 270-275 or approved equivalent.
 4. Control wrenches, wire stops, casing nuts, and stainless steel wire.
 5. Paint cover plate to match ceiling color or as directed by Architect.

2.06 ACCESS DOORS

- A. Duct Pressure Class 2-inch WC and Greater: Sandwich-type design with threaded locking bolt assembly. Closed cell neoprene gasket permanently bonded to inside panel. Zinc-coated steel wing nuts or polypropylene molded knobs with threaded metal inserts - zinc coated bolts sealed to inner panel.
- B. Duct Pressure Class 1-1/2-inch WC and Less: Galvanized steel assembly incorporating frame, door, hinges, and latch(es). Frame tabbed for attachment to duct panel. Double wall door panel with 1-inch insulation. Open cell neoprene gasket attached to frame. Cam latches for tight closure.
- C. Plenum Doors: Extruded aluminum frames with extruded santoprene seals. Double-wall 20 gauge galvanized steel door panel with fiberglass insulation.
- D. Size: Maximum size available to fit rectangular duct panel dimension or round duct diameter. Plenum doors minimum 2-feet wide by 4-feet high.
- E. For outdoor installation, only provide waterproof access doors installed vertically.

2.07 DUCT TEST HOLES

- A. Temporary Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct insulation thickness.
- B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.08 COMBINATION FIRE AND SMOKE DAMPERS

- A. Basis-of-Design:
 - 1. Ruskin Model FSD25R, Leakage Class 1, 1-1/2 hour rated, for round ductwork up to 24-inch diameter.
 - 2. Ruskin Model FSD60, Leakage Class I, 1-1/2 hour rated, for rectangular ducts or round ductwork larger than 24-inch diameter. Provide duct transition between round and rectangular connections. Pressure drop of a 24-inch by 24-inch damper at 1,000 and 2,000 fpm face velocity shall not exceed 0.03 and 0.16 in-wc., respectively.
 - 3. - C, for use in tunnel corridor applications.
 - 4. - FA, front access models.
 - 5. - SS, Stainless Steel Models for use in stainless steel ductwork.
 - 6. - M, modulating.
 - 7. - VALR, for use in validated systems.
 - 8. - XP, for use in explosion proof applications.
 - 9. - 3, for use in 3-hour rated assemblies.
- B. Ratings:
 - 1. Fire Resistance: UL 555 classified and provide combination fire and smoke dampers with UL label for fire rating as appropriate for construction rating and in conformance with NFPA 90A.
 - 2. Smoke Rating: Leakage Class Smoke Damper in accordance with UL555S. Leakage class at 4-inch wg
 - 3. Elevated Temperature Rating: 250 degrees F or 350 degrees F.
 - 4. Air Flow Rating: 2,000 feet per minute.
 - 5. Differential Pressure Rating: 4-inch wg.
- C. Construction:
 - 1. Frame: 16 gauge roll formed, galvanized steel hat-shaped channel, reinforced at corners. Structurally equivalent to 13 gauge U-channel type frame.
 - 2. Blades (Leakage Class II):
 - a. Style: Single skin with 3 longitudinal grooves.
 - b. Action: Opposed.

- c. Material: Minimum 16 gauge galvanized steel.
- d. Width: Maximum 6-inches.
- 3. Blades (Leakage Class I):
 - a. Style: True airfoil-shaped, single piece, double skin.
 - b. Action: Opposed.
 - c. Material: Minimum 14 gauge equivalent thickness, galvanized steel.
 - d. Width: Maximum 6-inches.
- 4. Bearings: Self-lubricating stainless steel sleeve type, turning in extruded hole in frame.
- 5. Seals:
 - a. Blade: Inflatable silicone fiberglass material to maintain smoke leakage rating to a minimum of 450 degrees F and galvanized steel for flame seal to 1,900 degrees F. Mechanically attached to blade edge (glue-on or grip type seals are not acceptable).
 - b. Jamb: Stainless steel, flexible metal compression type.
- 6. Linkage: Concealed in frame.
- 7. Axles: Minimum 1/2-inch diameter plated steel, hex-shaped, mechanically attached to blade.
- 8. Mounting: Vertical or Horizontal, based on application.
- 9. Temperature Release Device: Heat actuated, Quick Detect.
 - a. Close (in a controlled manner) and lock damper during test, smoke detection, power failure, or fire conditions through actuator closure spring. Actuator, at no time, to disengage from damper blades.
 - b. Allow damper to be automatically and remotely reset after test or power failure conditions. After exposure to high temperature or fire, inspect damper before reset to ensure proper operation.
 - c. Controlled closing and locking of damper in 7 to 15 seconds to allow duct pressure to equalize. Instantaneous closure is not acceptable.
- 10. Release Temperature: 165 degrees F, 212 degrees F, 250 degrees F, 285 degrees F, or 350 degrees F.
- 11. Actuator: Electric, two-position, fail close.
- 12. Finish: Mill galvanized for installation in galvanized sheet metal and Type 304 stainless steel for installation in stainless steel ductwork.
- 13. Firestat:
 - a. UL classified dual temperature device allows the damper to be re-opened after initial closure from high heat.
 - b. Electrically and mechanically locks damper in closed position when duct temperatures exceed 165 degrees F or 212 degrees F.
 - c. Allow damper to remain operable through a high limit temperature sensor for smoke management purposes while temperature is below 250 degrees F or 350 degrees F.
 - d. Replaces EFL or PFL Ruskin Controlled Closure heat actuated temperature release devices on standard dampers.
 - e. Blade position indicator switches: Two position indicator switches linked directly to damper blade in order to allow remote indication of damper blade position. Provide separate switches for indication of closed and open position.
- 14. Indicator or Auxiliary Switch Packages: Not required.
- D. Factory mounting angles.
- E. Factory Sleeve:
 - 1. Minimum 20 gauge thickness.
 - a. Silicone caulk factory applied to sleeve at damper frame to comply with leakage rating requirements.
 - b. Factory breakaway connections.
 - c. Factory Tests: Factory cycle damper and actuator assembly to assure proper operation.

2.09 FLEXIBLE CONNECTORS

- A. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- B. Metal-Edged Connectors: Factory fabricated with a fabric strip 4-inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Select metal compatible with ducts.
- C. Provide a spring and bracket assembly to reinforce the fabric with sufficient tension to prevent connector collapse under negative or positive pressure. Number and positioning of spring-link fixture to be determined by the manufacturer to maintain straight axis and without kinks between two sections of duct, or between duct and the moving element. Hardcast Spring-Link SL-200, or equal.
- D. Indoor System, Flexible Connector Fabric (FC-I): Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 ounces per square yard.
 - 2. Tensile Strength: 300 pounds of force per inch in the warp and 225 pounds of force per inch in the filling.
 - 3. Service Temperature: -40 degrees F to 200 degrees F.
- E. Outdoor System, Flexible Connector Fabric (FC-O): Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 30 ounces per square yard.
 - 2. Tensile Strength: 475 pounds of force per inch in the warp and 375 pounds of force per inch in the filling.
 - 3. Service Temperature: -40 degrees F to 200 degrees F.
- F. High-Temperature System, Flexible Connectors (FC-HT): Glass fabric coated with silicone rubber.
 - 1. Minimum Weight: 16 ounces per square yard.
 - 2. Tensile Strength: 285 pounds of force per inch in the warp and 185 pounds of force per inch in the filling.
 - 3. Service Temperature: -67 degrees F to 500 degrees F.
- G. High-Corrosive-Environment System, Flexible Connectors (FC-HC): Glass fabric with chemical-resistant coating.
 - 1. Minimum Weight: 14 ounces per square yard.
 - 2. Tensile Strength: 450 pounds of force per inch in the warp and 340 pounds of force per inch in the filling.
 - 3. Service Temperature: -67 degrees F to 500 degrees F.

END OF SECTION

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Centrifugal Fans
 - 2. In-Line Centrifugal Fans

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material gauges and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Motors: Premium efficiency per Section 23 05 13, Common Motor Requirements for HVAC Equipment. Electrically Commutated Motors (ECM) where scheduled on Drawings.
 - 2. Sound power levels as scheduled on Drawings. If not scheduled, within 5 percent of Basis of Design at design flow.
 - 3. Project Altitude: Base air ratings on sea-level conditions for project sites below 2,000 feet in elevation. Base air ratings on actual site elevations for project sites above 2,000 feet in elevation.
 - 4. Operating Limits: Classify according to AMCA 99.
 - 5. 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.
 - 6. AMCA Compliance: Products are to comply with performance requirements and are to be licensed to use the AMCA-Certified Ratings Seal.
 - 7. NEMA Compliance: Motors and electrical accessories are to comply with NEMA standards.
 - 8. UL Standard: HVAC Fans are to comply with UL 705. Fans used in grease exhaust applications are to be UL 762 listed for grease exhaust.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

- B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.
- C. Lift and support units with manufacturer's designated lifting or supporting points.

1.08 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.09 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. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Centrifugal Fans:
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City
- B. In-Line Centrifugal Fans:
 - 1. Greenheck
 - 2. Cook
 - 3. Twin City

2.02 CENTRIFUGAL FANS

- A. Description: Centrifugal or utility type centrifugal fans, as indicated, standard factory finish, AMCA rated, single width, single inlet, double width, double inlet, forward curved, backward inclined, or airfoil blades as scheduled.
- B. Wheel and Inlet:
 - 1. Backward Inclined: Steel or aluminum construction with smooth curved inlet flange, heavy back plate, backwardly curved blades welded or riveted to flange and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
 - 2. Airfoil Wheel: Steel construction with smooth curved inlet flange, heavy back plate die formed hollow airfoil shaped blades continuously welded at tip flange, and back plate; cast iron or cast steel hub riveted to back plate and keyed to shaft with set screws.
 - 3. Statically and dynamically balance wheel within its own bearings with maximum balance quality grade at bearings of G16 (0.20 in/sec peak velocity, filter-in as measured at fan RPM) for 5 hp and below and G6.3 (0.15 in/sec peak velocity, filter-in as measured at fan RPM) for 7.5 hp and above per ANSI S2.19. AMCA 210 rated.
- C. Housing:
 - 1. Heavy gauge steel, spot welded for AMCA 99 Class I and II fans, and continuously welded for Class III, adequately braced, designed to minimize turbulence with spun inlet bell and shaped cut.
 - 2. Finish: Factory finish to manufacturer's standard (Permatector) or Factory finish to manufacturer's standard with Hi-Pro polyester finish exceeding 1,000 hours of salt spray under ASTM B117 test method. For fans handling air downstream of humidifiers, provide two additional coats of paint or fabricate of galvanized steel. Prime coating of aluminum parts is not allowed.
 - 3. Removable angles and bolts for attaching flexible connections and discharge dampers on fan outlet.
 - 4. Housing Discharge Arrangement: Adjustable to eight standard positions.
- D. Bearings and Drives

1. Bearings: Heavy duty pillow block type, self-greasing ball bearings, with ABMA 9 L-10 life at 100,000 hours.
 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil, and shaft guard. Provide anti-corrosive coating.
 3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with sheaves set at mid-position fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor.
 4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 5. Belt Guard: Fabricate to SMACNA Duct Construction Standards - Metal and Flexible; 0.106-inch thick, 3/4-inch diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation, with provision for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
- E. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.
- F. Accessories:
1. Inlet/Outlet Screens: Galvanized steel welded grid, removable, at unit outlet for outdoor installation, and unit inlet for unducted conditions.
 2. Access Doors: Shaped to conform to scroll, with quick opening latch type handles and gaskets.
 3. Scroll Drain: 1/2-inch steel pipe coupling welded to low point of fan scroll for outdoor installation.
 4. AMCA 99 Type B spark proof construction where scheduled.
 5. Protective coating on fan wheel and interior of fan housing where scheduled. Apply coating before balancing fans and repair any breaks in coating which occur during balancing. One 6-mil coat of white plastic #7122 and one 6-mil coat of black plastic #7122.
 6. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.

2.03 IN-LINE CENTRIFUGAL FANS

- A. Description: In-line, belt-driven, centrifugal fans consisting of housing, wheel, outlet guide vanes, fan shaft, bearings, motor and disconnect switch, drive assembly, mounting brackets, and accessories.
- B. Wheel: Cast aluminum backward inclined with inlet cone statically and dynamically balanced within its own bearings.
- C. Housing:
1. Heavy gauge steel or aluminum, suitable for Fan Class, flat roof cap, hooded wall cap, pitched roof cap, elbow discharge with grille, and louvered wall discharge housing, factory standard finish.
 2. Removable panels for access to all interior components.
 3. Horizontal or vertical configuration, as indicated.
 4. Inlet and discharge duct collars.
 5. 1-inch thick, 1.5 pounds per cubic foot density fiberglass liner.
 6. Aluminum straightening vanes.
 7. Support bracket adaptable to floor, sidewall, or ceiling mounting.
- D. Bearings and Drives:
1. Bearings: Heavy duty pillow block type, self greasing ball bearings with ABMA 9 life at 50,000 hours.
 2. Shafts: Hot rolled steel, ground and polished, with keyway, protectively coated with lubricating oil.
 3. Drive: Cast iron or steel sheaves, dynamically balanced, keyed. Variable and adjustable pitch sheaves for motors 5 hp and under, selected so required rpm is obtained with

- sheaves set at mid-position. Fixed sheave for 7.5 hp and over, matched belts, and drive rated as recommended by manufacturer or minimum 1.5 times nameplate rating of motor. Motor mounted on adjustable base, with adjustable sheaves, enclosure around belts within fan housing, and lubricating tubes from fan bearings extended to outside of fan housing.
- a. Inverter duty motor for use with variable frequency drive where indicated on Fan Schedule on Drawings.
4. Drive: Direct drive matched to fan loads with speed controller. Motor encased in housing outside of airstream, factory wired to disconnect switch located on outside of fan housing.
 - a. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- E. Accessories:
1. Belt guard.
 2. Motor cover for outdoor applications.
 3. Inlet and outlet guard.
 4. AMCA 99 Type B spark proof construction where scheduled.
 5. Variable-Speed Controller: Provide solid-state control to reduce speed from 100 percent to less than 50 percent for motors 1/2 HP or smaller.
 6. Discharge Dampers: Parallel blade for mixing or open/close applications and opposed blade for modulating . Heavy duty steel or aluminum, where scheduled. Damper assembly with blades constructed of two plates formed around and welded to shaft, channel frame, sealed ball bearings, with blades linked out of air stream to single control lever. Motorized where indicated and gravity actuated with counterweight, where motorized is not indicated.
- F. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
- G. Vibration Isolation: Wheel and motor mounted on integral double deflection neoprene isolators.
- H. Vibration isolation as scheduled and specified. Reference Section 23 05 48, Vibration and Seismic Controls for HVAC Piping and Equipment.
1. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.

END OF SECTION

SECTION 23 36 00 - AIR TERMINAL UNITS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Single Duct Variable Volume and Constant Volume Units

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Air Terminal Units:
 - 1. Titus
 - 2. Price
 - 3. Krueger
 - 4. Nailor
 - 5. Greenheck

2.02 SINGLE DUCT VARIABLE VOLUME AND CONSTANT VOLUME UNITS

- A. Casings: Minimum 22 gauge galvanized steel.
- B. 1/2-inch dual density insulation which complies with UL 181 and NFPA 90A. Exposed insulation edges to be coated with NFPA 90A approved sealant to prevent entrainment of fibers in the airstream.
- C. Plenum Air Inlets: Round stub connections or S slip drive connections for duct attachment.
- D. Plenum Air Outlets: S slip and drive connections.
- E. Casing Leakage: Maximum casing leakage not to exceed 10 cfm at 1-inch static pressure for inlet size larger than 12-inches and not to exceed 7 cfm at 1-inch static pressure for inlet size 12-inches and smaller.
 - 1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
 - 2. Volume Damper: Construct of galvanized steel with peripheral gasket and self lubricating bearings; maximum damper leakage: 7 cfm maximum at inlet static pressure. Shaft to be clearly marked on the end to indicate damper position. Stickers or other removable markings are not acceptable. Damper to incorporate a mechanical stop to prevent overstroking and a synthetic seal to limit close off leakage to the maximum values shown in the damper leakage table.
 - 3. Flow Sensor: Integral averaging type flow sensor utilizing multiple sensing points with unit mounted calibration chart.

- 4. Mount damper operator to position damper normally open.
- F. Attenuator Section: Line attenuator sections with 2-inch thick insulation.
- G. Hot Water Heating Coil:
 - 1. Construction: 1/2-inch copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 PSIG pressure, factory installed.
- H. Acoustics: Sound ratings tested as power level 10-12 watts in accordance with AHRI 880 I-P at 1.5-inches wg inlet static pressure. NC ratings calculated per AHRI 885 with room attenuations as listed in Appendix E, and not to exceed values scheduled on drawings.
 - 1. MAXIMUM AIRBORNE SOUND POWER (db)
 - a. OCTAVE BAND AND CENTER FREQUENCY (HZ)
 - b. Units must have 5-feet of 2-inch thick lined duct downstream of terminal unit.

CFM	2	3	4	5	6	7
	125	250	500	1K	2K	4K
0-300	69	65	63	60	60	55
301-400	70	69	64	60	60	55
401-800	72	70	67	64	60	55
801-1100	74	71	68	67	60	60
1101-1700	75	73	70	67	60	60
1701 and above	80	78	76	67	63	62

- I. DDC Controls: Damper operator, sensor, and other devices compatible with temperature controls specified in Section 23 09 00, Instrumentation and Control Performance Specifications.
- J. Electric Controls: 24-V damper actuator with wall-mounted electric thermostat and appropriate mounting hardware.
- K. Electronic Controls: Bidirectional damper operator and microprocessor-based controller with integral airflow transducer and room sensor provide control with the following features:
 - 1. Proportional plus integral control of room temperature.
 - 2. Time-proportional reheat-coil control.
 - 3. Occupied/unoccupied operating mode.
 - 4. Remote reset of airflow or temperature set points.
 - 5. Adjusting and monitoring with portable terminal.
 - 6. Communication with temperature-control system specified in other Division 23, HVAC sections.

END OF SECTION

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Grilles, Registers, Diffusers
 - 2. Louvers

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished; indicate construction, finish, and mounting details.
 - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
 - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size and accessories furnished.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Air Distribution Diffuser, Register, and Grille Schedule lists Basis of Design, with any specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design:
 - a. Construction materials and appearance.
 - b. Frame/installation method.
 - c. Isothermal throw plus or minus 5 percent at design flows shown on drawings.
 - d. Noise Criteria: NC value plus or minus 1 at design flows shown on drawings.
 - e. Accessories: Equal to Basis of Design.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. General: Manufacturer's standard products of categories and types required for each application as referenced in other Division 23, HVAC sections, where more than a single type is specified for the application, provide single selection for each product category.
- B. Grilles, Registers, Diffusers:
 - 1. Anemostat
 - 2. Carnes
 - 3. Environmental Air Products
 - 4. Krueger
 - 5. Metalaire
 - 6. Nailor

7. Price Co.
8. Shoemaker
9. Titus
10. Tuttle & Bailey
11. Seiho
12. Or approved equivalent.

C. Louvers:

1. Ruskin Manufacturing
2. Pottorff
3. Carnes
4. Cesco
5. Greenheck
6. Or approved equivalent.

2.02 GRILLES, REGISTERS, DIFFUSERS

- A. Diffuser, Register and Grille Schedule lists Basis of Design, with specialty accessories, construction, finish or other criteria noted on schedule. Submitted air distribution must match criteria of Basis of Design, including accessories and finish:
 1. Matching construction materials and appearance. Equal installation method/frame.
 2. Pressure drop equal to or less than Basis of Design at CFM on Drawings.
 3. Throw: Isothermal jet throw plus or minus 5 percent of Basis of Design at CFM listed on Drawings.
 4. Noise Criteria: Plus or minus 1 NC of Basis of Design at CFM listed on Drawings. If Basis of Design NC is below registered level, submitted must match. NC rating with 10 dB room factor or less.
- B. Provide 1-, 2-, 3-, or 4-way deflection as indicated on Drawings.
- C. Provide pattern controllers for linear supply air diffusers.
- D. Register Dampers: Dampers utilized with grilles. Opposed blade dampers utilizing a side operated worm drive which provides external duct operation. Slot the end of the shaft to receive a screwdriver. Factory assembled side operator. Construct of the same material as the grille. Manufacturer same as grilles/diffuser.
- E. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

2.03 LOUVERS

- A. General: Frame and sill styles compatible with adjacent substrate, specifically manufactured to fit into construction openings with accurate fit and adequate support for weatherproof installation. Reference Drawings and Specifications for types of substrate which will contain each type of louver. Construct of aluminum extrusions, ASTM B221, Alloy 6063-T5. Weld units or use stainless steel fasteners. On inside face of exterior louvers, provide anodized aluminum wire bird screen mounted in removable extruded aluminum frames. AMCA licensed performance ratings.
- B. Blades set 3 to 5-inches on center, 37.5 degree angle with rain hook on blade, minimum blade thickness 0.080-inch, drainable blade style. Minimum 57 percent free area for 48-by 48-inch unit. Maximum water penetration 0.01 ounce water psf free area at 1000 FPM. Maximum intake pressure drop of 0.10-inch wg at 750 FPM free velocity. Provide downspouts in jambs, designed to drain water from louver for minimum water cascade from blade to blade. Provide drain gutter in head frame and each blade.
- C. Reference Drawings for free area required.
- D. Provide access door in duct to clean birdscreen.

- E. Finish: Factory Kynar 500 fluoropolymer spray finish; color to be selected by Architect. Conform to AAMA 605.2. Apply coating following cleaning, and pretreatment. Dry louvers before final finish application. 1.2 mils total dry film thickness when baked at 450 degrees F for ten minutes.

END OF SECTION

SECTION 23 40 00 - HVAC AIR CLEANING DEVICES

PART 1 - GENERAL

1.01 SUMMARY

- A. Work Included:
 - 1. Disposable Panel Filters
 - 2. Medium Efficiency Pleated Filters
 - 3. High Efficiency Pleated Filters
 - 4. Filter Gauges

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Division 01, General Requirements, Temporary Facilities and Controls: Filters for temporary heating and ventilating.
 - 2. Division 26, Electrical, Equipment Wiring: Electrical characteristics and wiring connections.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ANSI/AHRI 850 I-P - Performance Rating of Commercial and Industrial Air Filter Equipment.
 - 2. ASHRAE Std 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air Cleaning Devices Used in General Ventilation for Removing Particulate Matter; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
 - 3. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
 - 4. Standard 52.2 - Method of testing general ventilation air-cleaning devices for removal efficiency by particle size.
 - 5. MIL-STD-282 - Filter Units, Protective Clothing, Gas-Mask Components, and Related Products: Performance-Test Methods; Military Specifications and Standards.
 - 6. UL 586 - High Efficiency, Particulate, Air Filter Units; Underwriters Laboratories Inc.
 - 7. UL 867 - Electrostatic Air Cleaners; Underwriters Laboratories Inc.
 - 8. UL 900 - Standard for Air Filter Units; Underwriters Laboratories Inc.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Product Data: Provide data on filter media, filter performance data, filter assembly and filter frames, dimensions, motor locations and electrical characteristics and connection requirements.
 - 2. Shop Drawings: Indicate filter assembly and filter frames, dimensions, motor locations, and electrical characteristics and connection requirements.
 - 3. Samples: Submit two samples of replacement filter media of each type and each filter frame.
 - 4. Manufacturer's Installation Instructions: Indicate assembly and change-out procedures.
 - 5. Operation and Maintenance Data: Include instructions for operation, changing, and periodic cleaning.
 - 6. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - a. See Division 01, General Requirements for additional provisions.
 - b. Extra Filters: One set of each type and size.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.07 PERFORMANCE REQUIREMENTS

- A. Conform to ANSI/AHRI 850 I-P - Performance Rating of Commercial and Industrial Air Filter Equipment, Section 7.4.
 - 1. Dust Spot Efficiency: Plus or minus 5 percent.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Filters:
 - 1. American Filtration Inc.
 - 2. AAF International/American Air Filter
 - 3. Camfil Farr Company
 - 4. Eco-Air Products
 - 5. Filtration Group
 - 6. Flanders Corporation
 - 7. Or approved equivalent.
- B. Filter Gauges:
 - 1. Dwyer Instruments
 - 2. H.O. Treric Co.
 - 3. Weiss Instruments
 - 4. Or approved equivalent.

2.02 DISPOSABLE PANEL FILTERS

- A. Media: UL 900 Class 2, fiber blanket, factory sprayed with flameproof, non-drip, non-volatile adhesive.
 - 1. Nominal Size: 12 x 24-inches.
 - 2. Thickness: 1-inch.
- B. Performance Rating:
 - 1. Face Velocity: 500 FPM.
 - 2. Face Velocity: 350 FPM (2.54 m/sec).
 - 3. Initial Resistance: 0.15-inch WG.
 - 4. Initial Resistance: 0.23-inch WG (37 Pa).
 - 5. Recommended Final Resistance: 0.50-inches WG.
 - 6. MERV Rating: 6.
- C. Casing: Cardboard frame.
- D. Holding Frames: 20 gauge minimum galvanized steel frame with expanded metal grid on outlet side and steel rod grid on inlet side, hinged with pull and retaining handles.

2.03 MEDIUM EFFICIENCY PLEATED FILTERS

- A. Media: Blend of cotton and polyester fiber, pleated, support grid, enclosing frame, UL 900.
 - 1. Thickness 2-inch.
- B. Performance Rating per ASHRAE Standard 52.2:

1. MERV 7.
 2. Dust Spot Efficiency: 25 to 30 percent.
 3. Face Velocity: 500 FPM.
 4. Initial Resistance: 0.30-inch WG.
 5. Recommended Final Resistance: 0.90-inches WG.
- C. Frame: Provide galvanized steel frame, including support hardware with air tight seal around frame, upstream servicing.

2.04 HIGH EFFICIENCY PLEATED FILTERS

- A. Media: Microfine glass fiber laminated to reinforcing backing, pleated, support grid, mechanically and chemically bonded to enclosing frame, UL Class 1.
1. Thickness: 12-inch.
- B. Performance Rating per ASHRAE Standard 52.1 and Standard 52.2:
1. MERV 9.
 2. Dust Spot Efficiency: 40 to 45 percent.
 3. Face Velocity: 500 FPM.
 4. Initial Resistance: 0.25 inch WG.
 5. Recommended Final Resistance: 1.50-inches WG.
- C. Frame: Provide galvanized steel frame, including support hardware with air tight seal around frame, upstream servicing.

2.05 FILTER GAUGES

- A. Direct Reading Dial: 3-1/2-inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 0-0.5-inch WG, 2 percent of full scale accuracy.
- B. Direct Reading Dial: 2-inch diameter diaphragm actuated dial in metal case, vent valves, black figures on white background, front recalibration adjustment, range 2.0-inch WG, 3 percent of full scale accuracy.
- C. Inclined Manometer: One piece molded plastic with epoxy coated aluminum scale, inclined-vertical indicating tube and built-in spirit level, range 0-3-inch WG, 3 percent of full scale accuracy.
- D. Accessories: Static pressure tips with integral compression fittings, 1/4-inch aluminum tubing, 2-way or 3-way vent valves.

END OF SECTION

SECTION 23 82 16 - AIR COILS

PART 1 - GENERAL

1.01 SUMMARY

- A. Work included: Materials, installation and testing of:
 - 1. Water Coils

1.02 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.03 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils (with Addenda 1, 2 & 3).
 - 2. ASTM B117 - Standard Practice for Operating Salt Spray Apparatus.

1.04 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements
- B. In addition, provide:
 - 1. Product data for each coil including performance, dimensions, operating weights, pressure ratings.
 - 2. Computer selection sheet indicating performance including hot and cold side entering and leaving fluid/air conditions, flows, pressure drops, square feet of heating surface, fouling factor, and heat transfer surface dimensions and configuration.
 - 3. Refrigerant Coils: Provide capacity plot of suction pressure versus total load.

1.05 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Coil capacity certified in accordance with AHRI 410, latest edition.

1.06 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Provide extended three year warranty for coils with corrosion protection coating.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. Water Coils:
 - 1. Pace
 - 2. Trane
 - 3. Daikin Applied
 - 4. Colmac
 - 5. York
 - 6. Heatcraft
 - 7. USA Coil
 - 8. Temtrol
 - 9. Or approved equivalent.

2.02 WATER COILS

- A. General: Extended surface type consisting of copper tubing mechanically expanded to bond with plate fins. Design for serpentine flow with one or more feeds from common supply and return headers. Arrange for counter flow operation with supply connections at the bottom.
- B. Performance: Provide capacity indicated at water flows no greater than scheduled.
- C. Factory Testing: Leak test coils under water at 300 PSIG minimum.
- D. Working Pressure: 150 PSIG and 250 PSIG.
- E. Construction:
 - 1. Tubing: Seamless copper.
 - 2. Fins: copper or aluminum die formed plates. Continuous within the coil casing.
 - 3. Casing: 16 gauge stainless steel or galvanized steel.
 - 4. Headers: Seamless copper tube brazed to heat transfer tubes. Provide high point air vent fitting and low point drain fitting.
 - 5. Connections: Same end for supply and return unless noted otherwise.
 - 6. Intermediate Supports: Provide for coils with finned length greater than 44-inches, with maximum spacing of 42-inches.
- F. Corrosion Protection: Baked on phenolic coating suitable for 3000 hours salt spray per ASTM-B117. Heresite P413.

END OF SECTION

SECTION 26 05 05
SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Removal of existing electrical equipment, wiring, and conduit in areas to be remodeled; removal of designated construction; dismantling, cutting and alterations for completion of the Work.
2. Disposal of materials.
3. Storage of removed materials.
4. Identification of utilities.
5. Salvaged items.
6. Protection of items to remain as indicated on Drawings.
7. Relocate existing equipment to accommodate construction.

1.2 SUBMITTALS

- A. Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work. Describe demolition removal procedures and schedule.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of capped utilities, conduits, and equipment abandoned in place.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State, Municipality, Highways, and Public Work's standard.

1.5 SCHEDULING

- A. Schedule work to coincide with new construction.
- B. Cease operations immediately when structure appears to be in danger and notify Architect/Engineer. Do not resume operations until directed.

1.6 COORDINATION

- A. Conduct demolition to minimize interference with adjacent and occupied building areas.
- B. Coordinate demolition work with Owner's representative and all other disciplines.

- C. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.
- D. Shut-down Periods:
 - 1. Arrange timing of shut-down periods of in service panels with Owner's representative. Do not shut down any utility without prior written approval.
 - 2. Keep shut-down period to minimum or use intermittent period as directed by Owner's representative.
 - 3. Maintain life-safety systems in full operation in occupied facilities, or provide notice minimum 72 hours in advance.
- E. Identify salvage items in cooperation with Owner.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify wiring and equipment indicated to be demolished serve only abandoned facilities.
- B. Verify termination points for demolished services.

3.2 PREPARATION

- A. Take care to ensure that there will be no damage to structural elements or portions thereof which are not to be removed. Erect and maintain temporary shoring, bracing, and other means to safeguard the structural integrity of the existing buildings and structures.
- B. Erect, and maintain temporary safeguards, including warning signs and lights, barricades, and similar measures, for protection of the public, Owner, Contractor's employees, and existing improvements to remain.
- C. Protect existing structures, facilities, and plant life from damage. Items damaged because of demolition operations shall be repaired or replaced, at no cost to the Owner.
- D. Temporary egress signage and emergency lighting.
- E. Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Telephone System: Maintain existing system in service.
- G. Existing Public Address System: Maintain existing system in service. Disable system only to make switchovers and connections. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION

- A. Demolition Drawings are based on casual field observation and existing record documents. Report discrepancies to Owner or Architect/Engineer before disturbing existing installation.
- B. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- C. Remove conduit, wire, boxes, and fastening devices to avoid any interference with new installation.
- D. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit and wiring servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- E. Disconnect and remove abandoned panelboards and distribution equipment.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- I. Remaining Circuits and Equipment: Reinstall existing electrical installations disturbed. Certain existing electrical installations may be in walls, ceilings or floors that are to be removed and are essential for the operation of other remaining installations. Where this condition occurs provide a new extension of original circuits, raceways, equipment and outlets to retain service continuity. Installations shall be concealed in finished areas.
- J. Reconnect equipment being disturbed by renovation work and required for continue service to or nearest available panel.
- K. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit and wiring which are not part of final project.
- L. Install temporary wiring and connections to maintain existing systems in service during construction.
- M. Perform work on energized equipment or circuits with experienced and trained personnel.
- N. Remove, relocate, and extend existing installations to accommodate new construction.
- O. Repair adjacent construction and finishes damaged during demolition and extension work.
- P. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components, including abandoned components above accessible ceiling finishes. Cut embedded support elements flush with walls and floors.
- Q. Clean and repair existing equipment to remain or to be reinstalled.
- R. Protect and retain power to existing active equipment remaining.

- S. Cap abandoned empty conduit at both ends.
- T. Jack-hammering
 - 1. Jack-hammering will be permitted only to a limited degree, and only with the prior written approval of the Owner.
 - 2. Do not jack-hammer within 2-inches of reinforcing or structural steel to remain; remove final 2-inches of material with chipping gun.

3.4 EXISTING PANELBOARDS

- A. Ring out circuits in existing panel affected by the Work. Where additional circuits are needed, reuse circuits available for reuse. Install new breakers.
- B. Tag unused circuits as spare.
- C. Where existing circuits are indicated to be reused, use sensing measuring devices to verify circuits feeding Project area or are not in use.
- D. Remove existing wire no longer in use from panel to equipment.
- E. Provide new updated directories where more than three circuits have been modified or rewired.

3.5 SALVAGE ITEMS

- A. Remove and protect items indicated on Drawings to be salvaged and turn over to Owner.
- B. Items of salvageable value may be removed as work progresses. Transport salvaged items from site as they are removed.

3.6 REUSABLE ELECTRICAL EQUIPMENT

- A. Carefully remove equipment, materials, or fixtures which are to be reused.
- B. Disconnect, remove, or relocate existing electrical material and equipment interfering with new installation.
- C. Relocate existing lighting fixtures as indicated on Drawings. Clean fixtures and re-lamp. Test fixture to see if it is in good working condition before installation at new location.

3.7 CUTTING AND PATCHING

- A. Make new openings neat, as close as possible to profiles indicated, and only to extent necessary for new work.
- B. Do not cut or alter structural members unless specifically indicated or approved, and do not damage reinforcing or structural steel to remain.
- C. At concrete, masonry, paving, and other materials where edges of cuts and holes will remain exposed in the completed work, make cuts using power-sawing and coring equipment. Do not

over cut at corners of cut openings – saw overruns will not be permitted. Core hole at corner of proposed openings to insert blade and chip square.

- D. Upon completion of cutting and coring, clean remaining surfaces of loose particles and dust.
- E. Repair and patch all holes and openings from the removed electrical equipment, outlet boxes, etc. Coordinate with the General Contractor and the Architect to include and provide finished to match adjacent area.

3.8 CLEANING

- A. Remove demolished materials as work progresses. Legally dispose.
- B. Keep workplace neat.
- C. Clean surfaces on which new materials will be applied, removing adhesives, bitumen, and other adhering materials, as necessary to furnish acceptable substrates for new materials.
- D. Perform sandblasting, chipping, grinding, acid washing, etching, and other work as required by conditions encountered and new materials involved
- E. Use of acids or other cleaning agents shall include neutralizing, washing, rinsing, and drying, as applicable.
- F. Determine substrate requirements for reconditions surfaces in cooperation with the manufacturer's representative and installer of each new installer involved.
- G. Clean surfaces on which new materials will be applied, removing adhesives, bitumen, and other adhering materials, as necessary to furnish acceptable substrates for new materials.

3.9 PROTECTION OF FINISHED WORK

- A. Do not permit traffic over unprotected floor surface.

END OF SECTION 26 05 05

SECTION 26 05 19
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes building wire and cable; service entrance cable; metal clad cable; and wiring connectors and connections.

1.2 REFERENCES

- A. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- B. National Fire Protection Association:
1. NFPA 70 - National Electrical Code with California Amendments.
 2. NFPA 262 - Standard Method of Test for Flame Travel and Smoke of Wires and Cables for Use in Air-Handling Spaces.
- C. Underwriters Laboratories, Inc.:
1. UL 1277 - Standard for Safety for Electrical Power and Control Tray Cables with Optional Optical-Fiber Members.

1.3 SYSTEM DESCRIPTION

- A. Product Requirements: Provide products as follows:
1. Solid conductor for feeders and branch circuits 12 AWG and smaller.
 2. Stranded conductors for control circuits.
 3. Conductor not smaller than 12 AWG for power and lighting circuits.
 4. Conductor not smaller than 14 AWG for control circuits.
 5. Increase wire size in branch circuits to limit voltage drop to a maximum of 3 percent.
 6. 10 AWG conductors for 20 ampere or larger as designated on plans for 120 volt branch circuit home runs longer than 75 feet.
- B. Wiring Methods: Provide the following wiring methods:
1. Concealed Dry Interior Locations: Use only building wire, Type THHN/THWN-2 insulation, in raceway.
 2. Exposed Dry Interior Locations: Use only building wire, Type THHN/THWN-2 insulation, in raceway.
 3. Above Accessible Ceilings: Use only building wire, Type THHN/THWN-2 insulation, in raceway.
 4. Wet or Damp Interior Locations: Use only building wire, Type THHN/THWN-2 insulation, in raceway.
 5. Exterior Locations: Use only building wire, Type XHHW-2 insulation, in raceway.

6. Underground Locations: Use only building wire, Type XHHW-2 insulation, in raceway.
7. Metal clad cable can be utilized at concealed dry interior locations and above accessible ceilings.

1.4 DESIGN REQUIREMENTS

- A. Conductor sizes are based on copper unless indicated as aluminum or "AL".
- B. When aluminum conductor is substituted for copper conductor, size to match circuit requirements, terminations, conductor ampacity and voltage drop. Contractor shall be responsible for verifying maximum number of aluminum conductors for substituted copper conductors in specified conduit.

1.5 SUBMITTALS

- A. Product Data: Submit for building wire and each cable assembly type.
- B. Design Data: Indicate voltage drop and ampacity calculations for aluminum conductors substituted for copper conductors.
- C. Test Reports: Indicate procedures and values obtained.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and circuits.

1.7 QUALITY ASSURANCE

- A. Provide wiring materials located in plenums with peak optical density not greater than 0.5, average optical density not greater than 0.15, and flame spread not greater than 5 feet when tested in accordance with NFPA 262.
- B. Perform Work in accordance with State, Municipality, Highways, and Public Work's standard.
- C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

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

1.9 FIELD MEASUREMENTS

- A. Verify field measurements are as indicated on Drawings.

1.10 COORDINATION

- A. Where wire and cable destination is indicated and routing is not shown, determine routing and lengths required.
- B. Wire and cable routing indicated is approximate unless dimensioned.
- C. Determine required separation between wire, cable and other work. Determine cable routing to avoid interference with other work.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Product Description: Single conductor insulated wire.
- B. Conductor: Copper.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 75 or 90 degrees C.
- E. Insulation Material: Thermoplastic.

2.2 SERVICE ENTRANCE CABLE

- A. Conductor: Copper.
- B. Insulation Voltage Rating: 600 volts.
- C. Insulation: Type SE.

2.3 METAL CLAD CABLE

- A. Conductor: Copper.
- B. Health Care Facility (HCF) rated.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation Temperature Rating: 90 degrees C.
- E. Insulation Material: Thermoplastic.
- F. Full-sized equipment grounding/bonding conductor.
- G. Interlocked Armor: The interlocking metal tape armor shall be aluminum and shall be green.
- H. Aluminum interlocking metal tape shall be formed and helically wrapped around the cable assembly such that the interlocked armor and aluminum grounding/bonding conductor are in intimate contact throughout the entire cable.
- I. Interlocked armor shall be listed as being suitable for grounding.

2.4 PLASTIC TAPE:

- A. Black 7 mil thick general purpose electrical tape, Scotch 33 plus or equal.

2.5 INSULATING RESIN:

- A. Use two part liquid epoxy resin with resin and catalyst in premeasured, sealed mixing pouch. Scotchcast 4 or equivalent.

2.6 REDUCING ADAPTERS:

- A. Burndy, Thomas and Betts or approved equal.

2.7 TERMINATIONS

- A. Terminal Lugs for Wires 6 AWG and Smaller: Solderless, compression type copper.
- B. Lugs for Wires 4 AWG and Larger: Color keyed, compression type copper, with insulating sealing collars.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify interior of building has been protected from weather.
- B. Verify mechanical work likely to damage wire and cable has been completed.
- C. Verify raceway installation is complete and supported.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 EXISTING WORK

- A. Remove exposed abandoned wire and cable, including abandoned wire and cable above accessible ceiling finishes. Patch surfaces where removed cables pass through building finishes.
- B. Disconnect abandoned circuits and remove circuit wire and cable. Remove abandoned boxes when wire and cable servicing boxes is abandoned and removed. Install blank cover for abandoned boxes not removed.
- C. Provide access to existing wiring connections remaining active and requiring access. Modify installation or install access panel.
- D. Extend existing circuits using materials and methods as specified.

- E. Clean and repair existing wire and cable remaining or wire and cable to be reinstalled.

3.4 INSTALLATION

- A. Route wire and cable to meet Project conditions.
 - 1. Wire and cable routing indicated is approximate unless dimensioned.
 - 2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
 - 3. Include wire and cable of lengths required to install connected devices within 10 ft. of location shown.
- B. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- C. Identify and color code wire and cable. Identify each conductor with its circuit number or other designation indicated.
- D. Special Techniques--Building Wire in Raceway:
 - 1. Pull conductors into raceway at same time.
 - 2. Install building wire 4 AWG and larger with pulling equipment.
- E. Special Techniques - Cable:
 - 1. Protect exposed cable from damage.
 - 2. Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
 - 3. Use suitable cable fittings and connectors.
- F. Special Techniques - Wiring Connections:
 - 1. Clean conductor surfaces before installing lugs and connectors.
 - 2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - 3. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
 - 4. Install split bolt connectors for copper conductor splices and taps, 6 AWG and larger.
 - 5. Install solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - 6. Install insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
 - 7. Terminate aluminum conductors with tin-plated, aluminum-bodied compression connectors only. Fill with anti-oxidant compound before installing conductor.
 - 8. Install suitable reducing connectors or mechanical connector adaptors for connecting aluminum conductors to copper conductors.
 - 9. Encapsulate below grade splices at outlet, pull and junction boxes with specified insulating resin kits. Make all splices watertight.
 - 10. Install waterproof wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller in outdoor or wet locations.
 - 11. Where oversized cables are used to accommodate voltage drop, whether a single or parallel feeder, provide appropriate reducing adapter and conductors for termination.
- G. Install solid conductors for branch circuits 12 AWG and smaller. Install crimp on fork terminals for device terminations.

- H. Install terminal lugs on ends of 600 volt wires unless lugs are furnished on connected device, such as circuit breakers.
- I. Size lugs in accordance with manufacturer's recommendations terminating wire sizes. Install 2-hole type lugs to connect wires 4 AWG and larger to copper bus bars.
- J. For terminal lugs fastened together such as on motors, transformers, and other apparatus, or when space between studs is small enough that lugs can turn and touch each other, insulate for dielectric strength of 2-1/2 times normal potential of circuit.

3.5 WIRE COLOR

- A. General:
 - 1. For wire sizes 10 AWG and smaller, install wire colors in accordance with the following:
 - a. Black, red, and blue for circuits at 120/208 volts single or three phase.
 - 2. For wire sizes 8 AWG and larger, identify wire with colored tape at terminals, splices and boxes. Colors are as follows:
 - a. Black, red, and blue for circuits at 120/208 volts single or three phase.
- B. Neutral Conductors: White. When two or more neutrals are located in one conduit, individually identify each with proper circuit number.
- C. Branch Circuit Conductors: Install three or four wire home runs with each phase uniquely color coded.
- D. Feeder Circuit Conductors: Uniquely color code each phase.
- E. Ground Conductors:
 - 1. For 6 AWG and smaller: Green.
 - 2. For 4 AWG and larger: Identify with green tape at both ends and visible points including junction boxes.

3.6 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 26 05 19

SECTION 26 05 26
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Rod electrodes.
2. Wire.
3. Grounding well components.
4. Mechanical connectors.
5. Exothermic connections.

1.2 REFERENCES

A. Institute of Electrical and Electronics Engineers:

1. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
2. IEEE 1100 - Recommended Practice for Powering and Grounding Electronic Equipment.

B. International Electrical Testing Association:

1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code, with California Amendments.
2. NFPA 99 - Standard for Health Care Facilities.

1.3 SYSTEM DESCRIPTION

A. Grounding systems use the following elements as grounding electrodes:

1. Metal underground water pipe.
2. Metal building frame.
3. Concrete-encased electrode.
4. Ground ring.
5. Rod electrode.
6. Plate electrode.

1.4 PERFORMANCE REQUIREMENTS

A. Grounding System Resistance: 25 ohms maximum.

1.5 SUBMITTALS

- A. Product Data: Submit data on grounding electrodes and connections.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of components and grounding electrodes.

1.7 QUALITY ASSURANCE

- A. Provide grounding materials conforming to requirements of NEC, IEEE 142, and UL labeled.
- B. Perform Work in accordance with State, Municipality, Highways, and Public Work's standard.
- C. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.9 PRE-INSTALLATION MEETINGS

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

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
- C. Do not deliver items to project before time of installation. Limit shipment of bulk and multiple-use materials to quantities needed for immediate installation.

1.11 COORDINATION

- A. Complete grounding and bonding of building reinforcing steel prior concrete placement.

PART 2 - PRODUCTS

2.1 ROD ELECTRODES

- A. Product Description:
 - 1. Material: Copper.
 - 2. Diameter: 0.75 inch.
 - 3. Length: 10 feet.
- B. Connector: Connector for exothermic welded connection.

2.2 WIRE

- A. Material: Stranded copper.
- B. Foundation Electrodes: 4/0 AWG or as indicated on drawings.
- C. Grounding Electrode Conductor: Copper conductor insulated.
- D. Bonding Conductor: Copper conductor insulated.

2.3 GROUNDING WELL COMPONENTS

- A. Well Pipe: 8 inches by 24 inches long concrete pipe with belled end.
- B. Well Cover: Cast iron with legend "GROUND" embossed on cover.

2.4 MECHANICAL CONNECTORS

- A. Description: Bronze connectors, suitable for grounding and bonding applications, in configurations required for particular installation.

2.5 EXOTHERMIC CONNECTIONS

- A. Product Description: Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify final backfill and compaction has been completed before driving rod electrodes.

3.2 PREPARATION

- A. Remove paint, rust, mill oils, surface contaminants at connection points.

3.3 EXISTING WORK

- A. Modify existing grounding system to maintain continuity to accommodate renovations.

- B. Extend existing grounding system using materials and methods as specified.

3.4 INSTALLATION

- A. Install in accordance with IEEE 142 and 1100.
- B. Install rod electrodes at locations as indicated on Drawings. Install additional rod electrodes to achieve specified resistance to ground.
- C. Install grounding and bonding conductors concealed from view.
- D. Install grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- E. Install 4/0 AWG bare copper wire in foundation footing or as indicated on Drawings.
- F. Bond together metal siding not attached to grounded structure; bond to ground.
- G. Bond together reinforcing steel and metal accessories in pool and fountain structures.
- H. Install ground grid under access floors. Construct grid of 4 AWG bare copper wire installed on 24 inch centers both ways. Bond each access floor pedestal to grid.
- I. Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Install 2 AWG bare copper bonding conductor.
- J. Install grounding and bonding in patient care areas to meet requirements of NFPA 99.
- K. Equipment Grounding Conductor: Install separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- L. Connect to site grounding system.
- M. Bond to lightning protection system.
- N. Install continuous grounding using underground cold water system and building steel as grounding electrode. Where water piping is not available, install artificial station ground by means of driven rods or buried electrodes.
- O. Permanently ground entire light and power system in accordance with NEC, including service equipment, distribution panels, lighting panelboards, switch and starter enclosures, motor frames, grounding type receptacles, and other exposed non-current carrying metal parts of electrical equipment.
- P. Install branch circuits feeding isolated ground receptacles with separate insulated grounding conductor, connected only at isolated ground receptacle, ground terminals, and at ground bus of serving panel.
- Q. Accomplish grounding of electrical system by using insulated grounding conductor installed with feeders and branch circuit conductors in conduits. Size grounding conductors in accordance with NEC. Install from grounding bus of serving panel to ground bus of served panel, grounding screw of receptacles, lighting fixture housing, light switch outlet boxes or metal enclosures of service equipment. Ground conduits by means of grounding bushings on terminations at panelboards with installed number 12 conductor to grounding bus.

- R. Grounding electrical system using continuous metal raceway system enclosing circuit conductors in accordance with NEC.
- S. Permanently attach equipment and grounding conductors prior to energizing equipment.

3.5 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground resistance testing in accordance with IEEE 142.
- D. Perform leakage current tests in accordance with NFPA 99.
- E. Perform continuity testing in accordance with IEEE 142.
- F. When improper grounding is found on receptacles, check receptacles in entire project and correct. Perform retest.

3.6 INDEPENDENT TESTING ORGANIZATION AND PERSONNEL

- A. Obtain the services of an independent third-party testing organization to perform electrical tests.
- B. Independent testing organization and personnel shall meet the requirements of NETA ATS 3.1 and 3.2.
- C. Provide written test results and a final report of electrical tests per NETA ATS 5.4 to Engineer.

END OF SECTION 26 05 26

SECTION 26 05 29
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Conduit supports.
2. Formed steel channel.
3. Spring steel clips.
4. Sleeves.
5. Mechanical sleeve seals.
6. Firestopping relating to electrical work.
7. Firestopping accessories.
8. Equipment bases and supports.

1.2 REFERENCES

A. ASTM International:

1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
4. ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

B. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved by Factory Mutual Research for Property Conservation.

C. National Fire Protection Association:

1. NFPA 70 - National Electrical Code with California Amendments.

D. Underwriters Laboratories Inc.:

1. UL 263 - Fire Tests of Building Construction and Materials.
2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
3. UL 1479 - Fire Tests of Through-Penetration Firestops.
4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
5. UL - Fire Resistance Directory.

1.3 DEFINITIONS

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetrations through building materials to arrest movement of fire, smoke, heat, and hot gases through fire rated construction.

1.4 SYSTEM DESCRIPTION

- A. Firestopping Materials: ASTM E119, ASTM E814, UL 263, UL 1479, to achieve fire ratings of adjacent construction in accordance with FM and UL Design Numbers noted on Drawings.
- B. Firestop interruptions to fire rated assemblies, materials, and components.

1.5 PERFORMANCE REQUIREMENTS

- A. Firestopping: Conform to applicable code, FM, and UL for fire resistance ratings and surface burning characteristics.
- B. Firestopping: Provide certificate of compliance from authority having jurisdiction indicating approval of materials used.

1.6 SUBMITTALS

- A. Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- B. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
 - 2. Firestopping: Submit data on product characteristics, performance and limitation criteria.
- C. Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- D. Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- E. Submit details and calculations for support and anchors that are not specifically detailed on the Drawings where required by California Building Standards Code, California Code of Regulations, Title 24. Pre-approved systems may be used as noted below only if the pre-approval is current and accepted by the local agency having jurisdiction.
- F. Where pre-approved bracing systems will be employed, submit:
 - 1. System component brochure describing components used and detailed installation instructions.
 - 2. Loads to be transmitted to the structure at anchor points.
- G. Where pre-approved bracing systems are not used, submit details and calculations of proposed systems. Include:
 - 1. Detailed drawings and calculations showing system to be installed, stamped by a Structural Engineer registered in the state of California.
 - 2. Loads to be transmitted to the structure at anchor points.
 - 3. Submit detailed routing and installation drawings of all raceway systems requiring seismic supports for review. Include attachment points, raceway sizes and methods proposed for securing and attaching.
- H. Manufacturer's Installation Instructions:

1. Hangers and Supports: Submit special procedures and assembly of components.
2. Firestopping: Submit preparation and installation instructions.

- I. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- J. Firestopping Engineering Judgments: For conditions not covered by UL listed designs, submit judgments by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.

1.7 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: UL 1479 or ASTM E814 with 0.10-inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 1. Wall Penetrations: Fire F-Ratings as indicated on Drawings, but not less than 1-hour.
 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on Drawings, but not less than 1-hour.
 - a. Floor Penetrations Within Wall Cavities: T-Rating is not required.
- B. Through Penetration Firestopping of Non-Fire Rated Floor and Roof Assemblies: Materials to resist free passage of flame and products of combustion.
 1. Noncombustible Penetrating Items: Noncombustible materials for penetrating items connecting maximum of three stories.
 2. Penetrating Items: Materials approved by authorities having jurisdiction for penetrating items connecting maximum of two stories.
- C. Fire Resistant Joints in Fire Rated Floor, Roof, and Wall Assemblies: ASTM E1966 or UL 2079 to achieve fire resistant rating as indicated on Drawings for assembly in which joint is installed.
- D. Fire Resistant Joints Between Floor Slabs and Exterior Walls: ASTM E119 with 0.10-inch water gage minimum positive pressure differential to achieve fire resistant rating as indicated on Drawings for floor assembly.
- E. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed index when tested in accordance with ASTM E84.
- F. Perform Work in accordance with State, Municipality, Highways, and Public Work's standard.
- G. Maintain one copy of each document on site.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing work of this section with minimum 3 years documented experience.

1.9 PRE-INSTALLATION MEETINGS

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

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below 60 degrees F.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to receive solvent cured materials.

PART 2 - PRODUCTS

2.1 CONDUIT SUPPORTS

- A. Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.
- B. Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.
- C. Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.
- D. Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.
- E. Cable Ties: High strength nylon temperature rated to 185 degrees F. Self-locking.

2.2 FORMED STEEL CHANNEL

- A. Product Description: Galvanized 12 gage thick steel.

2.3 SPRING STEEL CLIPS

- A. Product Description: Mounting hole and screw closure.

2.4 SLEEVES

- A. Sleeves for Through Non-fire Rated Floors: 18 gage thick galvanized steel.

- B. Sleeves for Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed.
- D. Fire-stopping Insulation: Glass fiber type, non-combustible.

2.5 MECHANICAL SLEEVE SEALS

- A. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

2.6 FIRESTOPPING

- A. Product Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements; provide only one type for each similar application.
 1. Silicone Firestopping Elastomeric Firestopping: Single component silicone elastomeric compound and compatible silicone sealant.
 2. Foam Firestopping Compounds: Single component foam compound.
 3. Formulated Firestopping Compound of Incombustible Fibers: Formulated compound mixed with incombustible non-asbestos fibers.
 4. Fiber Stuffing and Sealant Firestopping: Composite of mineral fiber stuffing insulation with silicone elastomer for smoke stopping.
 5. Mechanical Firestopping Device with Fillers: Mechanical device with incombustible fillers and silicone elastomer, covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.
 6. Intumescent Firestopping: Intumescent putty compound which expands on exposure to surface heat gain.
 7. Firestop Pillows: Formed mineral fiber pillows.
- B. Color: Dark gray.

2.7 FIRESTOPPING ACCESSORIES

- A. Primer: Type recommended by firestopping manufacturer for specific substrate surfaces and suitable for required fire ratings.
- B. Dam Material: Permanent:
 1. Mineral fiberboard.
 2. Mineral fiber matting.
 3. Sheet metal.
 4. Plywood or particle board.
 5. Alumina silicate fire board.
- C. Installation Accessories: Provide clips, collars, fasteners, temporary stops or dams, and other devices required to position and retain materials in place.

D. General:

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

E. Non-Rated Surfaces:

1. Stamped steel, chrome plated, hinged, split ring escutcheons or floor plates or ceiling plates for covering openings in occupied areas where conduit is exposed.
2. For exterior wall openings below grade, furnish modular mechanical type seal consisting of interlocking synthetic rubber links shaped to continuously fill annular space between conduit and cored opening or water-stop type wall sleeve.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing materials to arrest liquid material leakage.
- D. Obtain permission from Architect/Engineer before using powder-actuated anchors.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION - HANGERS AND SUPPORTS

A. Anchors and Fasteners:

1. Concrete Structural Elements: Provide precast inserts and expansion anchors.
2. Steel Structural Elements: Provide beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.
3. Concrete Surfaces: Provide self-drilling anchors and expansion anchors.
4. Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide toggle bolts.
5. Solid Masonry Walls: Provide expansion anchors and preset inserts.
6. Sheet Metal: Provide sheet metal screws.
7. Wood Elements: Provide wood screws.

B. Inserts:

1. Install inserts for placement in concrete forms.

2. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
 5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.
- C. Install conduit and raceway support and spacing in accordance with NEC.
- D. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- E. Install multiple conduit runs on common hangers.
- F. Supports:
1. Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.
 2. Install surface mounted cabinets and panelboards with minimum of four anchors.
 3. In wet and damp locations install steel channel supports to stand cabinets and panelboards 1 inch off wall.
 4. Support vertical conduit at every floor.

3.4 INSTALLATION - FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating.
- D. Place intumescent coating in sufficient coats to achieve rating required.
- E. Remove dam material after firestopping material has cured.
- F. Fire Rated Surface:
1. Seal opening at floor, wall, partition, ceiling, and roof as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c. Pack void with backing material.
 - d. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.
 2. Where cable tray, bus, cable bus, conduit, wireway, and trough penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.
- G. Non-Rated Surfaces:

1. Seal opening through non-fire rated wall, partition, floor, ceiling, and roof opening as follows:
 - a. Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - b. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
 - c. Install type of firestopping material recommended by manufacturer.
2. Install floor plates or ceiling plates where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
3. Exterior wall openings below grade: Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
4. Interior partitions: Seal pipe penetrations at clean rooms, laboratories, hospital spaces, computer rooms, telecommunication rooms, and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches thick and extending 6 inches beyond supported equipment.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with adjustable interlocking rubber links.
- B. Conduit penetrations not required to be watertight: Sleeve and fill with silicon foam.
- C. Set sleeves in position in forms. Provide reinforcing around sleeves.
- D. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- E. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.
- F. Where conduit or raceway penetrates floor, ceiling, or wall, close off space between conduit or raceway and adjacent work with fire stopping insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- G. Install chrome plated steel escutcheons at finished surfaces.

3.7 FIELD QUALITY CONTROL

- A. Inspect installed firestopping for compliance with specifications and submitted schedule.

3.8 CLEANING

A. Clean adjacent surfaces of firestopping materials.

3.9 PROTECTION OF FINISHED WORK

A. Protect adjacent surfaces from damage by material installation.

END OF SECTION 26 05 29

SECTION 26 05 33
RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes conduit, surface raceways, wireways, outlet boxes, pull and junction boxes, and handholes.

1.2 REFERENCES

- A. American National Standards Institute:

1. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
2. ANSI C80.3 - Specification for Electrical Metallic Tubing, Zinc Coated.
3. ANSI C80.5 - Aluminum Rigid Conduit - (ARC).

- B. National Electrical Manufacturers Association:

1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
2. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
3. NEMA OS 1 - Sheet Steel Outlet Boxes, Device Boxes, Covers, and Box Supports.
4. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers, and Box Supports.
5. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
6. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Tubing and Conduit.
7. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 SYSTEM DESCRIPTION

- A. Raceway and boxes located as indicated on Drawings, and at other locations required for splices, taps, wire pulling, equipment connections, and compliance with regulatory requirements. Raceway and boxes are shown in approximate locations unless dimensioned. Provide raceway to complete wiring system.
- B. Underground More than 5 feet outside Foundation Wall: Provide thickwall nonmetallic conduit. Provide cast metal boxes or nonmetallic handhole.
- C. Underground Within 5 feet from Foundation Wall: Provide thickwall nonmetallic conduit. Provide cast metal or nonmetallic boxes.
- D. In Slab Above Grade: Not permitted.
- E. Below Slab on Grade: Use thickwall nonmetallic conduit. Terminate with coated rigid steel elbows and short length of coated rigid steel conduit out of concrete.
- F. Outdoor Locations, Above Grade: Provide galvanized rigid steel conduit. Provide cast metal outlet, pull, and junction boxes.

- G. Wet and Damp Locations: galvanized rigid steel conduit. Provide cast metal outlet, junction, and pull boxes. Provide flush mounting outlet box in finished areas.
- H. Concealed Dry Locations: Provide electrical metallic tubing. Provide sheet-metal boxes. Provide flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes where shown on drawings.
- I. Exposed Interior Dry Locations: Use rigid steel conduit or intermediate metal conduit below eight feet or where subject to damage. Use rigid steel conduit, intermediate metal conduit, or electrical metallic tubing above eight feet or in electrical, mechanical or telecommunication rooms. Use sheet-metal or cast metal boxes. Use flush mounting outlet box in finished areas. Provide hinged enclosure for large pull boxes.

1.4 DESIGN REQUIREMENTS

- A. Minimum Raceway Size:
 - 1. 0.75 inch unless otherwise specified.
 - 2. 1 inch for Homeruns unless otherwise specified.
 - 3. 1 inch for outside foundation line unless otherwise specified.

1.5 SUBMITTALS

- A. Product Data: Submit for the following:
 - 1. Flexible metal conduit.
 - 2. Liquidtight flexible metal conduit.
 - 3. Nonmetallic conduit.
 - 4. Flexible nonmetallic conduit.
 - 5. Raceway fittings.
 - 6. Conduit bodies.
 - 7. Surface raceway.
 - 8. Wireway.
 - 9. Pull and junction boxes.
 - 10. Handholes.
- B. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.6 CLOSEOUT SUBMITTALS

- A. Project Record Documents:
 - 1. Record actual routing of conduits larger than 2 inches.
 - 2. Record actual locations and mounting heights of outlet, pull, and junction boxes.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.
- B. Protect PVC conduit from sunlight.

1.8 COORDINATION

- A. Coordinate mounting heights, orientation and locations of outlets mounted above counters, benches, and backsplashes.
- B. Coordinate Work of this Division and Work of other Divisions in advance of installation. Provide additional Work to overcome tight conditions at no increase in Contract Sum.
- C. Coordinate installation of outlet boxes for equipment specified in other divisions.

PART 2 - PRODUCTS

2.1 METAL CONDUIT

- A. Rigid Steel Conduit: ANSI C80.1.
- B. Rigid Aluminum Conduit: ANSI C80.5.
- C. Intermediate Metal Conduit (IMC): Rigid steel.
- D. Fittings and Conduit Bodies: NEMA FB 1. Fittings shall be steel/malleable iron with threaded fittings. Use insulated metallic bushings with lug where ground connections are required. Use plastic bushing for non-bonding applications.

2.2 PVC COATED METAL CONDUIT

- A. Product Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel fittings with external PVC coating to match conduit.

2.3 FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction.
- B. Fittings: NEMA FB 1.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

- A. Product Description: Interlocked steel construction with PVC jacket.
- B. Fittings: NEMA FB 1.

2.5 ELECTRICAL METALLIC TUBING (EMT)

- A. Product Description: ANSI C80.3; galvanized tubing.
- B. Fittings and Conduit Bodies: NEMA FB 1; steel couplings and connectors. Box connectors shall have with insulated throat. Set screw type couplings.

2.6 NONMETALLIC CONDUIT

- A. Product Description: NEMA TC 2; Schedule 40 PVC for normal power and 80 PVC for emergency power.
- B. Fittings and Conduit Bodies: NEMA TC 3.

2.7 WIREWAY

- A. Product Description: General purpose for indoor applications and raintight type for outdoor locations wire way.
- B. Knockouts: Manufacturer's standard.
- C. Cover: Hinged cover with full gaskets.
- D. Connector: Flanged.
- E. Fittings: Lay-in type with removable top, bottom, and side; captive screws and drip shield for outdoor.
- F. Finish: Rust inhibiting primer coating with gray enamel finish.

2.8 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS 1, galvanized steel.
 - 1. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; furnish 0.5-inch male fixture studs where required.
 - 2. Boxes for shall be 1.5-inch-deep by 4-inch square minimum.
 - 3. Boxes for telecommunications outlets shall be 2-1/8-inch-deep by 4-11/16-inch square minimum. Provide 1-gang device ring.
 - 4. Concrete Ceiling Boxes: Concrete type.
- B. Nonmetallic Outlet Boxes: NEMA OS 2.
- C. Cast Boxes: NEMA FB 1, Type FD, aluminum. Furnish gasketed cover by box manufacturer. Furnish threaded hubs.

2.9 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS 1, galvanized steel.
- B. Hinged Enclosures: As specified in Section 262716.

- C. Surface Mounted Cast Metal Box: NEMA 250, Type 4X; flat-flanged, surface mounted junction box:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.
- D. In-Ground Cast Metal Box: NEMA 250, Type 6, outside flanged, recessed cover box for flush mounting:
 - 1. Material: Galvanized cast iron.
 - 2. Cover: Nonskid cover with neoprene gasket and stainless-steel cover screws.
 - 3. Cover Legend: "ELECTRIC".
- E. Concrete composite Handholes: Die-molded, concrete composite hand holes:
 - 1. Cable Entrance: Pre-cut 6-inch x 6-inch cable entrance at center bottom of each side.
 - 2. Extension: 12" reinforced concrete below box.
 - 3. Cover: Concrete composite cover with nonskid finish. Covers shall be marked "ELECTRIC", "SIGNAL", "GROUND" or as indicated on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet locations and routing and termination locations of raceway prior to rough-in.

3.2 EXISTING WORK

- A. Remove exposed abandoned raceway, including abandoned raceway above accessible ceiling finishes. Cut raceway flush with walls and floors, and patch surfaces.
- B. Remove concealed abandoned raceway to its source.
- C. Disconnect abandoned outlets and remove devices. Remove abandoned outlets when raceway is abandoned and removed. Install blank cover for abandoned outlets not removed.
- D. Maintain access to existing boxes and other installations remaining active and requiring access. Modify installation or provide access panel.
- E. Extend existing raceway and box installations using materials and methods [compatible with existing electrical installations, or] as specified.
- F. Clean and repair existing raceway and boxes to remain or to be reinstalled.

3.3 INSTALLATION

- A. Ground and bond raceway and boxes.
- B. Fasten raceway and box supports to structure and finishes.
- C. Identify raceway and boxes.

- D. Arrange raceway and boxes to maintain headroom and present neat appearance.

3.4 INSTALLATION - RACEWAY

- A. Raceway routing is shown in approximate locations unless dimensioned. Route to complete wiring system.
- B. Arrange raceway supports to prevent misalignment during wiring installation.
- C. Support raceway using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- D. Group related raceway; support using conduit rack. Construct rack using steel channel and provide space on each for 25 percent additional raceways.
- E. Do not support raceway with wire or perforated pipe straps. Remove wire used for temporary supports
- F. Do not attach raceway to ceiling support wires or other piping systems.
- G. Construct wire way supports from steel channel.
- H. Route exposed raceway parallel and perpendicular to walls.
- I. Route raceway installed above accessible ceilings parallel and perpendicular to walls.
- J. Route conduit in and under slab from point-to-point.
- K. Maintain clearance between raceway and piping for maintenance purposes.
- L. Maintain 12-inch clearance between raceway and surfaces with temperatures exceeding 104 degrees F.
- M. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- N. Bring conduit to shoulder of fittings; fasten securely.
- O. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for minimum 20 minutes.
- P. Install conduit hubs to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.
- Q. Install no more than equivalent of three 90-degree bends between boxes. Install conduit bodies to make sharp changes in direction, as around beams. Install factory elbows for bends in metal conduit larger than 2-inch size.
- R. Avoid moisture traps; install junction box with drain fitting at low points in conduit system.
- S. Install fittings to accommodate expansion and deflection where raceway crosses seismic and expansion joints.
- T. Install suitable pull string or cord in each empty raceway except sleeves and nipples.

- U. Install suitable caps to protect installed conduit against entrance of dirt and moisture.
- V. Surface Raceway: Install flat-head screws, clips, and straps to fasten raceway channel to surfaces; mount plumb and level. Install insulating bushings and inserts at connections to outlets and corner fittings.
- W. Close ends and unused openings in wire way.

3.5 INSTALLATION - BOXES

- A. Adjust box location up to 10 feet prior to rough-in to accommodate intended purpose.
- B. Orient boxes to accommodate wiring devices.
- C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- D. In Accessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.
- E. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- F. Do not install flush mounting box back-to-back in walls; install with minimum 6 inches separation. Install with minimum 24 inches separation in acoustic rated walls.
- G. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- H. Install stamped steel bridges to fasten flush mounting outlet box between studs.
- I. Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- J. Install adjustable steel channel fasteners for hung ceiling outlet box.
- K. Do not fasten boxes to ceiling support wires or other piping systems.
- L. Support boxes independently of conduit.
- M. Install gang box where more than one device is mounted together. Do not use sectional box.
- N. Install gang box with plaster ring for single device outlets.

3.6 INSTALLATION CONCRETE COMPOSITE HANDHOLES

- A. Install boxes flush with finished grade or surface material.
- B. Provide hold down bolts for all covers.
- C. Provide minimum 12" depth of crushed rock or pea gravel below boxes for drainage. Ground bond steel cover plate with insulated green grounding conductor.

3.7 INTERFACE WITH OTHER PRODUCTS

- A. Install conduit to preserve fire resistance rating of partitions and other elements.
- B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.
- C. Locate outlet boxes to allow luminaires positioned as indicated on reflected ceiling plan.
- D. Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.

3.8 ADJUSTING

- A. Adjust flush-mounting outlets to make front flush with finished wall material.
- B. Install knockout closures in unused openings in boxes.

3.9 CLEANING

- A. Clean interior of boxes to remove dust, debris, and other material.
- B. Clean exposed surfaces and restore finish.

END OF SECTION 26 05 33

SECTION 26 05 53
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nameplates.
 - 2. Labels.
 - 3. Wire markers.
 - 4. Conduit markers.
 - 5. Stencils.
 - 6. Underground Warning Tape.
 - 7. Lockout Devices.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Submit manufacturer's catalog literature for each product required.
 - 2. Submit electrical identification schedule including list of wording, symbols, letter size, color coding, tag number, location, and function.
- B. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.3 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of tagged devices; include tag numbers.

1.4 QUALITY ASSURANCE

- A. Perform Work in accordance with State, Municipality, Highways, Public Work's standard.

1.5 QUALIFICATIONS

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

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept identification products on site in original containers. Inspect for damage.

- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Install labels and nameplates only when ambient temperature and humidity conditions for adhesive are within range recommended by manufacturer.

PART 2 - PRODUCTS

2.1 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on white contrasting background color.
- B. Letter Size:
 - 1. 0.125 inch high letters for identifying individual equipment and loads.
 - 2. 0.25 inch high letters for identifying grouped equipment and loads.

Specify requirements for letter sizes for other applications.

- C. Minimum nameplate thickness: 0.125 inch.

2.2 LABELS

- A. Labels: Embossed adhesive tape, with 0.125 inch white letters on black background.

2.3 WIRE MARKERS

- A. Description: Self-adhering, pre-printed, machine printable or write-on, self-laminating vinyl wrap around strips. Blank markers shall be inscribed using the printer or pen recommended by manufacturer for this purpose.
- B. Legend:
 - 1. Power and Lighting Circuits: Branch circuit or feeder number as indicated on Drawing
 - 2. Control Circuits: Control wire number as indicated on shop drawings.

2.4 CONDUIT AND RACEWAY MARKERS

- A. Description: Nameplate fastened with straps.
- B. Color:

1. 480 Volt System: Orange lettering on white background.
2. 208 Volt System: Blue lettering on white background.
3. Fire Alarm System: Red lettering on white background.

C. Legend:

1. 480 Volt System: 480 VOLTS.
2. 208 Volt System: 208 VOLTS.
3. Fire Alarm System: FIRE ALARM.

2.5 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 2 inches Outside Diameter of Raceway: 0.5 inch high letters.
2. 2.5 to 6 inches Outside Diameter of Raceway: 1 inch high letters.

B. Stencil Paint: Semi-gloss enamel, colors conforming to the following:

1. Black lettering on white background.
2. White lettering on gray background.
3. Red lettering on white background.
4. Blue lettering on white background.

2.6 UNDERGROUND WARNING TAPE

A. Description: 4 inch wide plastic tape, detectable type, color yellow with suitable warning legend describing buried electrical lines.

2.7 LOCKOUT DEVICES

A. Lockout Hasps:

1. Anodized aluminum hasp with erasable label surface; size minimum 7.25 x 3 inches.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 EXISTING WORK

- A. Install identification on existing equipment to remain in accordance with this section.
- B. Install identification on unmarked existing equipment.
- C. Replace lost nameplates, labels, and markers.

- D. Re-stencil existing equipment.

3.3 INSTALLATION

- A. Install identifying devices after completion of painting.

- B. Nameplate Installation:

1. Install nameplate parallel to equipment lines.
2. Install nameplate for each electrical distribution and control equipment enclosure with corrosive-resistant mechanical fasteners, or adhesive.
3. Install nameplates for each control panel and major control components located outside panel with corrosive-resistant mechanical fasteners, or adhesive.
4. Secure nameplate to equipment front using screws.
5. Secure nameplate to inside surface of door on recessed panelboard in finished locations.
6. Install nameplates for the following:
 - a. Switchboards.
 - b. Switchgear.
 - c. Motor Control Centers.
 - d. Distribution Panelboards
 - e. Panelboards.
 - f. Transformers.
 - g. Service Disconnects.
 - h. Fused and Non-Fused Disconnects.
 - i. Automatic Transfer Switches.

- C. Provide color coded nameplates that present, as applicable, the following information:

1. Equipment or device designation.
2. Amperage, kVA, or horsepower rating where applicable.
3. Voltage or signal system name.
4. Source or power or control.
5. Examples:
 - a. Boards: CH2A; 1000A; 277/480V, 3-Phase, 4-Wire.
 - b. Feeder Power Supply for Panel "XXX" Originates at Panel "XXX".
 - c. Transformers: T-1; 112.5kVA; 480V to 120/208V, 3-Phase, 4-Wire; Served from H2A; Load Served L2A.
 - d. Disconnects and Individual Motor Starters: AHU-1; 25HP; 480V, 3-Phase, 3-Wires; Served from EHD5.
 - e. Available Fault Current: XX,XXX Amperes. Date Calculated: XX/XX/XX.

- D. Color coding for nameplates for power systems:

1. 277/480V Normal – Yellow with black letters.
2. 277/480V Emergency/Battery – Red with white letters.
3. 120/208V Normal – Blue with white letters.
4. 120/208V Emergency/Battery – Red with white letters.
5. UPS Power – Orange with black letters.

- E. Color coding for nameplates for signal systems:

1. Fire alarm and life safety - Red with black letters.

2. Nurse call - Light Blue with white letters.
3. Security - Green with white letters.
4. Clock/Intercom/Sound/MATV/CATV - Magenta with white letters.
5. Energy Management System – White with black letters.

F. Label Installation:

1. Install label parallel to equipment lines.
2. Install label for identification of individual control device stations, receptacles, and switches.
3. Install labels for permanent adhesion and seal with clear lacquer.
4. Identify receptacle and light switch cover plate with panel and branch circuit number, (for example L2A-3), with thermal transfer laminated adhesive tape with 1/8 inch black letters on clear tape cartridge.

G. Wire Marker Installation:

1. Install wire marker for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection.
2. Mark data cabling at each end. Install additional marking at accessible locations along the cable run.
3. Install labels at data outlets identifying patch panel and port designation as indicated on Drawings.

H. Conduit Marker Installation:

1. Install conduit marker for each conduit longer than 6 feet.
2. Conduit Marker Spacing: 20 feet on center.

I. Junction Box Identification

1. Color code and identify all junction boxes located above suspended ceilings and below ceilings in non-public areas.
2. Use finish paint suitable for use on metal surfaces.
3. Boxes shall be identified with permanent felt tip marker on cover indicating panel and circuit numbers. Paint junction box covers using the color coding listed below.
 - a. 480/277 Volt System: Orange.
 - b. 208/120 Volt System: Blue.
 - c. Fire Alarm System: Red.
 - d. Security System: Green.
 - e. Nurse Call System: Yellow

J. Underground Warning Tape Installation:

1. Install underground warning tape along length of each underground conduit, raceway, or cable 8 inches below finished grade, directly above buried conduit, raceway, or cable.

K. BRASS TAGS:

1. Provide brass tags for all feeder cables in underground vaults and pull boxes.
2. Provide brass tags for empty conduits in underground vaults, pull boxes and stubs.

L. WARNING, CAUTION AND INSTRUCTION SIGNS

1. Provide warning, caution or instruction signs where required by OSHA, where indicated, or where reasonably required to assure safe operation and maintenance of electrical systems.
 - a. Install engraved plastic-laminated instruction signs with approved legend where instructions or explanations are needed for system of equipment operation
 - b. Provide polyester film self-adhesive signs for indoor/outdoor equipment and door warning. Use rigid polyethylene non-adhesive signs where adhesives will not work; for example, installing on a metal fence. Provide sign color and marking that meets OSHA regulations. For example, DANGER (red background with white letters), HIGH VOLTAGE (white with black letters).
 - 1) Use 2 by 4 inch signs for small equipment or enclosure doors.
 - 2) Use 7 by 10 inch or 10 by 14 inch signs for large equipment or enclosure doors.
2. Emergency Operating Signs: Install engraved laminate signs with white letters on red background with minimum 3/8 inch high lettering for emergency instructions on power transfer, load shedding, or other emergency operations.

END OF SECTION 26 05 53

SECTION 26 05 83
WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes electrical connections to equipment.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Product Data: Submit wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- B. Manufacturer's installation instructions.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations, sizes, and configurations of equipment connections.

1.5 COORDINATION

- A. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
- B. Determine connection locations and requirements.
- C. Sequence rough-in of electrical connections to coordinate with installation of equipment.
- D. Sequence electrical connections to coordinate with start-up of equipment.

PART 2 - PRODUCTS

2.1 CORD AND PLUGS

- A. Attachment Plug Construction: Conform to NEMA WD 1.
- B. Configuration: NEMA WD 6; match receptacle configuration at outlet furnished for equipment.

- C. Cord Construction: Type SO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- D. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify equipment is ready for electrical connection, for wiring, and to be energized.

3.2 EXISTING WORK

- A. Remove exposed abandoned equipment wiring connections, including abandoned connections above accessible ceiling finishes.
- B. Disconnect abandoned utilization equipment and remove wiring connections. Remove abandoned components when connected raceway is abandoned and removed. Install blank cover for abandoned boxes and enclosures not removed.
- C. Extend existing equipment connections using materials and methods as specified.

3.3 INSTALLATION

- A. Make electrical connections.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Install receptacle outlet to accommodate connection with attachment plug.
- E. Install cord and cap for field-supplied attachment plug.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.
- J. Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.

3.4 ADJUSTING

- A. Cooperate with utilization equipment installers and field service personnel during checkout and starting of equipment to allow testing and balancing and other startup operations. Provide personnel to operate electrical system and checkout wiring connection components and configurations.

END OF SECTION 26 05 83

SECTION 26 09 23
AUTOMATIC LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. The work covered under this section is subject to the requirements in the General Conditions of the specifications. Contractor shall coordinate the work in this section with the trades covered in other sections of the specification to provide a complete and operable system.

1.2 SYSTEM DESCRIPTION

- A. Extent of lighting control system work is indicated by drawings and by the requirements of this section. It is the intent of this section to provide an integrated energy savings lighting control system including: Wall and ceiling mounted occupancy sensors, control panels, and demand responsive controls. Controls shall be from a single supplier. Contractor is responsible for confirming that the panels and sensors interoperate as a single system.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's standard product data for each system component.
- B. Manufacturer's Installation Instructions: Submit for each system component.
- C. Shop Drawings: Indicate dimensioned drawings of lighting control system components and accessories.
 - 1. One Line Diagram: Indicating system configuration indicating panels, number and type of switches or devices.
 - 2. Include typical wiring diagrams for each component.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Submit replacement parts numbers.
 - 2. Submit manufacturer's published installation instructions and operating instructions.
 - 3. Recommended renewal parts list.
- B. Project Record Documents: Record following information:
 - 1. Actual locations of components and record circuiting and switching arrangements.
 - 2. Wiring diagrams reflecting field installed conditions with identified and numbered system components and devices.

1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Accept components on Site in manufacturer's packaging. Inspect for damage.
- B. Protect components by storing in manufacturer's containers indoor protected from weather.

1.7 WARRANTY

- A. Furnish five-year manufacturer's warranty for components.

1.8 EXTRA MATERIALS

- A. Furnish two of each power pack type.
- B. Furnish two of each occupancy sensor type.

PART 2 - PRODUCTS

2.1 DEMAND RESPONSIVE CONTROLS

- A. A system shall be installed that has the capability to perform Demand Responsive Controls, per California Title 24.
- B. Be centrally located and protected so that only a qualified personnel may operate it.
- C. Have network capabilities.
- D. All accessories and power supplies shall be outlined in submittals and identified on drawings.

2.2 WALL MOUNTED OCCUPANCY SENSORS

A. SINGLE SWITCH TYPE

1. Shall use microprocessor for motion signal analysis and internal, adaptive self-adjustment.
2. No manual adjustment shall be required at the time of installation or during operation.
3. Shall automatically adapt to changing room conditions—with the ability to disable adaptive features.
4. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
5. Shall recognize motion detected within 20 seconds of turning off lighting as a false off. In response to a false off, the microprocessor shall increase the time-off setting.
6. Maximum adapted time-out shall not exceed 30 minutes.
7. Walk through feature shall shut off lights within 2.5 minutes after momentary occupancy.
8. Shall have a 3-position service switch: off, auto, and on.
9. Four, selectable manual timer settings shall be available from 30sec to 20min.

10. Rating: 1800W/VA @ 120V, 4000VA @ 277V, and 1/4HP @ 120VAC.
11. Separate switches for low voltage and line voltage shall be identified on documents, and coordinated with luminaire schedule.
12. Dimmer switches when utilized with occupancy sensors, shall operate at 0-10V dimming protocol, with 10% capability.

B. DUAL SWITCH TYPE

1. No manual adjustment shall be required at the time of installation or during operation.
2. Shall provide switching for 2 separate banks from a single unit.
3. Shall use microprocessor for motion signal analysis and internal, adaptive self-adjustment.
4. Shall save learned and adjusted settings in non-volatile memory that retains all settings during power outages.
5. No manual adjustment shall be required at the time of installation or during operation.
6. Shall automatically adapt to changing room conditions—with the ability to disable adaptive features.
7. Maximum adapted time-out shall not exceed 30 minutes.
8. Walk through feature shall shut off lights within 2.5 minutes after momentary occupancy.
9. Shall offer two modes of operation:
10. Only one relay responds to photocell.
11. Both relays respond to photocell and lights return to the previous state on the next cycle.
12. Shall have a 3-position service switch: off, auto, and on.
13. Four, selectable manual timer settings shall be available from 30sec to 20min.
14. Ratings: Primary Relay - 800W @ 120V, 1200VA @120V, 2700VA @ 277V @ 120VAC; Secondary Relay - 800W @ 120V, 800VA @120V, 1200VA @ 277V.
15. Separate switches for low voltage and line voltage shall be identified on documents, and coordinated with luminaire schedule.
16. Dimmer switches when utilized with occupancy sensors, shall operate at 0-10V dimming protocol, with 10% capability.

2.3 CEILING MOUNTED OCCUPANCY SENSOR

A. Dual-Technology Ceiling/Upper Wall Mount

1. Shall incorporate Doppler shift ultrasonic and passive infrared motion detection technologies.
2. Shall mount on the ceiling or upper wall via supplied mounting bracket.
 - a. Mounting bracket shall have a place to conceal the wiring bracket.
3. Shall be available in 180° and 360° coverage patterns.
4. Infrared lenses shall have a 360° field of view.
5. Coverage pattern: 1000 square feet minimum.
6. Shall be available in 40kHz ultrasonic frequencies.
7. Shall automatically adapt to changing room conditions—including background PIR levels and continuous airflow.
8. Sensor shall have two modes of operation:
 - a. Multi-technology mode: where the sensors send infrared signal to the microprocessor, which makes the decision to turn on lighting based on the level of the signal.
 - b. Single technology mode: where the user chooses technology that will turn on lighting.
9. Shall incorporate a real-time motion indicator LED, which is visible from the front of unit.
10. Shall have mask inserts for PIR rejection to prevent false tripping.

11. Low-Voltage sensors shall incorporate power/relay packs into their design, quantity specified, and location.
12. Separate switches for low voltage and line voltage shall be identified on documents, and coordinated with luminaire schedule.

B. Power Pack

1. Shall be compatible with LED, incandescent, magnetic or electronic low voltage, and magnetic or electronic fluorescent, as well as motor loads.
2. Ratings: 20A LED, 20A incandescent, 20A fluorescent @ 50Hz or 60Hz. Shall utilize normally open, silver alloy dry contacts rated for a 20A-driver/ballast load at 120V, 277V.
3. Relay function shall not require more than 5-ma control current to operate.
4. Power Pack shall allow for separation of Class 1 and Class 2 wiring.
5. Power Pack Mounting Specifications
 - a. Shall fit inside the driver/ballast cavity of a luminaire, and shall be qualified for installation in a driver/ballast cavity.
 - b. Shall be sized to fit inside a standard, 4" x 4" junction box.
 - c. Shall be mountable to a 1/2in. knockout within a driver/ballast cavity on the line voltage end, such that it may be mounted to the outside of a junction box with the line voltage wiring internal to the box and the low voltage wiring external.
 - d. Shall be mountable to a 1/2in. knockout within a driver/ballast cavity on the low voltage end, such that it may be mounted to the inside of a driver/ballast cavity with the box and line voltage wiring internal to the cavity and the low voltage wiring external.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Mount sensors as indicated on Drawings.
- B. Use only properly color coded, stranded wire. Install wire sizes as indicated on Drawings. Install non-plenum rated wire, or as indicated on drawings, in conduit.
- C. Label each low voltage wire clearly indicating connecting relay panel.
- D. Mount relay as indicated on Drawings. Wire numbered relays in panel to control power to each load. Install relays to be accessible. Allow space around relays for ventilation and circulation of air.
- E. Identify power wiring with circuit breaker number controlling load. When multiple circuit breaker panels are feeding into relay panel, label wires to indicate originating panel designation.
- F. Label each low voltage wire with relay number at each switch or sensor.

3.2 ADJUSTING

- A. Test each system component after installation to verify proper operation.
- B. Test relays, contactors, and switches after installation to confirm proper operation.

- C. Adjust daylight controllers to automatically turn lights on and off at dusk and dawn.
- D. Confirm correct loads are recorded on directory card in each panel.

3.3 DEMONSTRATION

- A. Upon completion of all line, load and interconnection wiring, and after all fixtures are installed and lamped, a qualified technician shall completely check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the test mode to see that lights turn off and on based on occupancy.
- B. At the time of checkout and testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.
- C. Demonstrate operation of the following system components:
 - 1. Operation of each type of occupancy sensors.
- D. Furnish 4 hours to instruct Owner's personnel in operation and maintenance of system. Schedule training with Owner, provide at least 7 days notice to owner of training date.

END OF SECTION 26 09 23

SECTION 26 24 16
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Distribution and branch circuit panelboards.
 2. Electronic grade branch circuit panelboards.

1.2 REFERENCE STANDARDS

- A. Institute of Electrical and Electronics Engineers:
1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- B. National Electrical Manufacturers Association:
1. NEMA FU 1 - Low Voltage Cartridge Fuses.
 2. NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC.
 3. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices.
 4. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
 5. NEMA PB 1 - Panelboards.
 6. NEMA PB 1.1 - General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.
- C. International Electrical Testing Association:
1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- D. National Fire Protection Association:
1. NFPA 70 - National Electrical Code with California Amendments.
- E. UL:
1. UL 50 - Cabinets and Boxes
 2. UL 67 - Safety for Panelboards.
 3. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
 4. UL 1283 - Electromagnetic Interference Filters.
 5. UL 1449 - Transient Voltage Surge Suppressors.
 6. UL 1699 - Arc-Fault Circuit Interrupters.

1.3 SUBMITTALS

- A. Product Data: Submit catalog data showing specified features of standard products.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker, and fusible switch arrangement and sizes.
- C. Source Quality control submittals: Indicate results of factory tests and inspections.
- D. Field Quality Control Submittals: Indicate results of Contractor furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. Project Record Documents: Record actual locations of panelboards and record actual circuiting arrangements.
- B. Operation and Maintenance Data: Submit spare parts listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals.

1.5 QUALITY ASSURANCE

- A. Qualifications
 1. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' documented experience.

PART 2 - PRODUCTS

2.1 DISTRIBUTION PANELBOARDS

- A. Description: NEMA PB 1, circuit breaker type panelboard.
- B. Operation:
 1. Minimum integrated short circuit rating as indicated on Drawings.
- C. Materials
 1. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
 2. Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Furnish circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
 3. Molded Case Circuit Breakers with Current Limiters: UL 489, circuit breakers with replaceable current limiting elements, in addition to integral thermal and instantaneous magnetic trip in each pole.
 4. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical A, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
 5. Circuit Breaker Accessories: Trip units and auxiliary switches as indicated on Drawings.
 6. Surge Suppressers: Integrated in panelboard.

7. Enclosure: NEMA PB 1, Type 1 for indoor and 3R for outdoor applications.
8. Cabinet Front: Surface door-in-door type, fastened with concealed trim clamps, hinged door with flush lock, and metal directory frame.

D. Finishes:

1. Manufacturer's standard gray enamel.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

B. Materials:

1. Panelboard Bus: Copper current carrying components, ratings as indicated on Drawings. Furnish copper ground bus in each panelboard.
2. For non-linear load applications subject to harmonics furnish 200 percent rated, plated copper, solid neutral.
3. Minimum Integrated Short Circuit Rating or as indicated on Drawings.
4. Molded Case Circuit Breakers: UL 489, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers as indicated on Drawings. Provide UL class 760 arc-fault interrupter circuit breakers as indicated on Drawings. Do not use tandem circuit breakers..
5. Current Limiting Molded Case Circuit Breakers: UL 489, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical A, let-through current and energy level less than permitted for same size NEMA FU 1, Class RK-5 fuse.
6. Surge Suppressor: Integrated in panelboard.
7. Enclosure: NEMA PB 1, Type 1 for indoor and Type 3R outdoor applications.
8. Cabinet Box: 6 inches deep, 20 inches.

C. Cabinet Front: Flush or surface cabinet front as indicated on drawings with door-in-door concealed trim clamps, concealed hinge, metal directory frame, and flush lock keyed alike.
Finishes:

1. Finish in manufacturer's standard gray enamel.

2.3 ELECTRONIC GRADE PANELBOARD

A. Description:

1. Integral Surge Suppressor: Component recognized according to UL 1449 and UL 1283.
2. Panelboard: UL 67 listed and TVSS device UL 1449 Component Recognized. TVSS device meets UL 1449. Furnish panelboard markings with clamp voltage at TVSS terminals and clamp voltage at panelboard line terminals.

B. Performance:

1. Integral Surge Suppressors:
 - a. Maximum single impulse current rating not less than 160 kA for each phase.

- b. Pulse Lift Test: Capable of protecting against and surviving 5000 IEEE C62.41 Category C transients without failure or degradation.
- c. Clamping Voltage:
 - 1) 208Y/120 Configuration:
 - a) L-N: 500 V.
 - b) N-G: 500 V.
 - c) L-G: 500 V.
 - 2) 480Y/277 Configuration:
 - a) L-N: 1,000 V.
 - b) N-G: 1,000 V.
 - c) L-G: 1,000 V.

C. Fabrication:

- 1. Integral Surge Suppressor:
 - a. Furnish copper bus bars for surge current path.
 - b. Construct using surge current modules (MOV based). Each module fused with user replaceable 200,000 AIR rated fuses. Status of each module monitored on front cover of panelboard enclosure and on module.
 - c. Furnish with audible alarm activated when one of surge current modules has failed. Furnish alarm on/off to silence alarm and alarm push-to-test switch to test alarm. Locate switches and alarm on front cover of panelboard enclosure.
 - d. Furnish response time no greater than five nanoseconds for individual protection modes.
 - e. Designed to withstand maximum continuous operating voltage (MCOV) of not less than 115 percent of nominal RMS voltage.
 - f. Furnish visible indication of proper suppresser connection and operation. Lights indicate operable phase and module.
 - g. Furnish minimum EMI/RFI filtering of 34 dB at 100 kHz with insertion loss ratio of 50:1 using Mil Std. 220A methodology.
- 2. Panelboards:
 - a. Top or bottom feed as indicated on Drawings. Furnish circuit directory inside door.
 - b. Construct box of galvanized steel. Box size as indicated on Drawings.
 - c. Main bus constructed of copper and rated for load current.
 - d. Furnish interior with branch circuit breakers. Furnish one 60 A circuit breaker, with appropriate number of poles, as dedicated disconnect for TVSS.
 - e. Furnish standard rated neutral assembly with copper neutral bus.
 - f. Furnish with insulated ground bus and safety ground bus.
 - g. Furnish wiring gutters according to NEC.
 - h. Field connections to panelboard: main breaker type.
 - i. Construct with flush or surface mounted trim as indicated on drawings.
 - j. Furnish with branch breaker positions and nominal current rating as indicated on Drawings.

2.4 SOURCE QUALITY CONTROL

- A. Independently test integral surge suppressers with category C3 high exposure waveform (20 kV-1.2/50us, 10kA-8/20 us) per IEEE C62.41.

PART 3 - EXECUTION

3.1 DEMOLITION

- A. Disconnect abandoned panelboards. Remove abandoned panelboards and load centers.
- B. Maintain access to existing panelboard and load centers remaining active and requiring access. Modify installation or provide access panel.

3.2 INSTALLATION

- A. Install panelboards according to NEMA PB 1.1.
- B. Install panelboards plumb.
- C. Install recessed panelboards flush with wall finishes.
- D. Height: 6 feet to top of panelboard; install panelboards taller than 6 feet with bottom no more than 4 inches above floor.
- E. Install filler plates for unused spaces in panelboards.
- F. Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes to balance phase loads. Identify each circuit as to its clear, evident and specific purpose of use.
- G. Install engraved plastic nameplates.
- H. Install spare conduits out of each recessed panelboard to accessible location above ceiling. Minimum spare conduits: five empty 1 inch. Identify each as spare.
- I. Ground and bond panelboard enclosure. Connect equipment ground bars of panels according to NFPA 70.
- J. Modifications to existing panelboards shall be as indicated on the Drawings. New equipment shall match existing where possible and in all cases be compatible with existing. Where new breakers are installed in existing equipment, provide all hardware and trim pieces as required for a complete closed installation. Provide new nameplates at equipment where existing breakers are identified by nameplates and provide new breaker identification in directory where existing breakers are identified in a directory.
- K. Where new breakers are indicated to be installed in existing panel, but insufficient space exists, provide enclosed circuit breakers externally and tap existing bussing. Tap conduit and wire sizes shall be same as breaker line side conduit and wire.

3.3 REPAIR/RESTORATION

- A. Repair existing panelboards to remain or to be reinstalled.

3.4 FIELD QUALITY CONTROL

- A. Inspect and test according to NETA ATS, except Section 4.
- B. Perform circuit breaker inspections and tests listed in NETA ATS, Section 7.6.

- C. Perform switch inspections and tests listed in NETA ATS, Section 7.5.
- D. Perform controller inspections and tests listed in NETA ATS, Section 7.16.1.

3.5 ADJUSTING

- A. Measure steady state load currents at each panelboard feeder; rearrange circuits in panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

3.6 CLEANING

- A. Clean existing panelboards and load centers to remain or to be reinstalled.

END OF SECTION 26 24 16

SECTION 26 27 26
WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes wall switches; receptacles; device plates; and decorative box covers.

1.2 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA WD 1 - General Requirements for Wiring Devices.
 - 2. NEMA WD 6 - Wiring Devices-Dimensional Requirements.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Samples: Submit two samples of each wiring device and wall plate illustrating materials, construction, color, and finish.

1.4 QUALIFICATIONS

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

PART 2 - PRODUCTS

2.1 WALL SWITCHES

- A. Product Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch. Refer to drawings for additional information.
- B. Body and Handle: White thermoplastic with toggle handle.
- C. Locator Light: Lighted handle type switch; red color handle.
- D. Ratings:
 - 1. Voltage: 120-277 volts, AC.
 - 2. Current: 20 amperes.
 - 3. Wiring: Back and side wired. Back wiring with clamp type terminals suitable for stranded or solid wire.

2.2 RECEPTACLES

- A. Product Description: Heavy Duty grade, NEMA WD 1. Combination head brass grounding screw. Brass alloy triple wipe contacts shall grip both sides of plug prongs.
- B. Device Body: White thermoplastic face.
- C. Configuration: NEMA WD 6.
- D. Convenience Receptacle: Type 5-20.
- E. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
- F. Wiring: Back and side wired. Back wiring with clamp type terminals suitable for stranded or solid wire.
- G. Tamper Resistant Receptacle: Convenience receptacle with internal spring loaded mechanical shutter. Type 5-20.
- H. Special Purpose Receptacles: Type and rating and number of poles indicated or required for the anticipated purpose.

2.3 WALL PLATES

- A. Decorative Cover Plate: Stainless Steel.
- B. Jumbo Cover Plate: Stainless Steel.
- C. Weatherproof Cover Plate: Gasketed cast metal plate with hinged and gasketed device cover. Provide extended cover for receptacles located in wet locations when attachment plug is inserted. Refer to drawings for additional information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify outlet boxes are installed at proper height.
- B. Verify wall openings are neatly cut and completely covered by wall plates.
- C. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

- A. Clean debris from outlet boxes.

3.3 EXISTING WORK

- A. Disconnect and remove abandoned wiring devices.
- B. Modify installation to maintain access to existing wiring devices to remain active.
- C. Clean and repair existing wiring devices to remain or to be reinstalled.

3.4 INSTALLATION

- A. Install devices plumb and level.
- B. Install switches with OFF position down.
- C. Install wall dimmers to achieve full rating specified and indicated after derating for ganging as instructed by manufacturer.
- D. Do not share neutral conductor on load side of dimmers.
- E. Install receptacles with grounding pole on top.
- F. Connect wiring device grounding terminal to outlet box with bonding jumper and branch circuit equipment grounding conductor.
- G. Install wall plates on flush mounted switches, receptacles, and blank outlets.
- H. Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- I. Connect wiring devices by wrapping solid conductor around screw terminal. Install stranded conductor for branch circuits 10 AWG and smaller. When stranded conductors are used in lieu of solid, use crimp on fork terminals for device terminations. Do not place bare stranded conductors directly under device screws.
- J. Use jumbo size plates for outlets installed in masonry walls.
- K. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- L. Provide weather resistant GFI receptacles with specified weatherproof covers for all receptacles installed outdoors or in damp or wet locations.
- M. Provide GFI receptacles for all receptacles installed within 6 feet of sinks.
- N. Provide GFI receptacles for all receptacles installed in kitchens.
- O. Provide GFI receptacles for all receptacles serving electric drinking fountains.
- P. Provide isolated ground receptacles for all receptacles serving computers and electronic cash registers.
- Q. Unless noted otherwise, do not use combination switch/receptacle devices.
- R. For flush floor service fittings, use tile rings for installations in tile floors.
- S. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

3.5 INTERFACE WITH OTHER PRODUCTS

- A. Coordinate locations of outlet boxes to obtain mounting heights as specified.
- B. Install wall switch/dimmers per drawings.
- C. Install convenience receptacle 18 inches to center of box above finished floor.
- D. Install convenience receptacle 6 inches to center of box above counter or back splash of counter.
- E. Install dimmer 44 inches to center of box above finished floor.

3.6 FIELD QUALITY CONTROL

- A. Inspect each wiring device for defects.
- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

3.7 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.8 CLEANING

- A. Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION 26 27 26

**SECTION 26 51 00
INTERIOR LIGHTING**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes interior luminaires and accessories.

1.2 SUBMITTALS

- A. Product Data: Submit dimensions, ratings, and performance data.
- B. Provide luminaires complete with lamps, completely wired, controlled, and securely attached to supports.

1.3 QUALIFICATIONS

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

1.4 ALTERNATE LUMINAIRES

- A. Contractor shall notify Architect/Engineer in writing prior to submittal being reviewed if it acceptable to increase weight of luminaire, mounting shown on drawings, increase/decrease in lumen output, or increase/decrease in wattage, as this may trigger a resubmittal to DSA to demonstrate this will not exceed calculated loads.

1.5 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

PART 2 - PRODUCTS

2.1 INTERIOR LUMINAIRES

- A. Product Description: Complete interior luminaire assemblies, with features, options, and accessories as scheduled.

PART 3 - EXECUTION

3.1 EXISTING WORK

- A. Disconnect and remove abandoned luminaires, lamps, and accessories.

- B. Extend existing interior luminaire installations using materials and methods compatible with existing installation or as specified.
- C. Clean and repair existing luminaires remaining or are to be reinstalled.

3.2 INSTALLATION

- A. Provide mounting accessories as required for ceiling installation. Luminaire catalog numbers do not necessarily denote specific mounting accessories for type of ceiling in which the luminaire may be installed.
- B. Install suspended luminaires using pendants supported from swivel hangers. Install pendant length required to suspend luminaire at indicated height.
- C. Support luminaires larger than 2 x 4 foot size independent of ceiling framing.
- D. Locate recessed ceiling luminaires as indicated on reflected ceiling plan.
- E. Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
- F. Install recessed luminaires to permit removal from below.
- G. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- H. Install clips to secure recessed grid-supported luminaires in place.
- I. Install wall-mounted luminaires at height as scheduled.
- J. Install accessories furnished with each luminaire.
- K. Connect undercounter luminaires to branch circuit outlets provided under Section 26 05 33 using flexible conduit.
- L. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- M. Install specified lamps in each luminaire.
- N. Exposed Grid Ceilings: Support surface mounted luminaires on grid ceiling directly from building structure.
- O. Ground and bond all luminaires.

3.3 FIELD QUALITY CONTROL

- A. Operate each unit after installation and connection. Inspect for proper connection and operation.

3.4 ADJUSTING

- A. Aim and adjust lamp fixtures as indicated on Drawings.

- B. Position exit sign directional arrows as indicated on Drawings.

3.5 CLEANING

- A. Remove dirt and debris from enclosures.
- B. Clean photometric control surfaces as recommended by manufacturer.
- C. Clean finishes and touch up damage.

3.6 PROTECTION OF FINISHED WORK

- A. Re-lamp luminaires having failed lamps at Substantial Completion.

END OF SECTION 26 51 00