

Cordilleras Mental Health Center Replacement Project

Specifications

**REFERENCE DESIGN
DOCUMENT**

**Volume One
Divisions 0 - 23**



Architecture | Engineering | Planning

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1.1 GENERAL

2.0 SUMMARY

- A. Removing above-grade site improvements within limits indicated.
- B. Disconnecting, capping or sealing, and abandoning site utilities in place.
- C. Disconnecting, capping or sealing, and removing site utilities.
- D. Disposing of objectionable material.

2.1 RELATED SECTIONS

- E. Section 311100 – Clearing and Grubbing.
- F. Section 311300 – Selective Tree Removal and Trimming.
- G. Section 311400 – Earth Stripping and Stockpiling.
- H. Section 312300 – Excavation and Fill.

2.2 DEFINITIONS

- I. ANSI: American National Standards Institute.
- J. CAL-OSHA: California Occupational Safety and Health Administration.

2.3 PROJECT CONDITIONS

- K. Except for materials indicated to be stockpiled or to remain the Owner's property, cleared materials are the Contractor's property. Remove cleared materials from site and dispose of in lawful manner.
- L. Salvable Improvements: Carefully remove items indicated to be salvaged and store where indicated on plans or where designated by the Owner. Avoid damaging materials designated for salvage.
- M. Unidentified Materials: If unidentified materials are discovered, including hazardous materials that will require additional removal other than is required by the Contract Documents, immediately report the discovery to the Owner. If necessary, the Owner will arrange for any testing or analysis of the discovered materials and will provide instructions regarding the removal and disposal of the unidentified materials.

1.2 PRODUCTS

2.0 SOIL MATERIALS

- N. Backfill excavations resulting from demolition operations with on-site or import materials conforming to structural backfill defined in Section 312300 Excavation and Fill.

1.3 EXECUTION

2.0 PREPARATION

- O. Protect and maintain benchmarks and survey control points during construction.
- P. Protect existing site improvements to remain during construction.

2.1 RESTORATION

- Q. Restore damaged improvements to their original condition, as acceptable to the Owner.

2.2 UTILITIES

- R. Locate, identify, disconnect, and seal or cap off utilities indicated to be removed or abandoned.
- S. Arrange to shut off indicated utilities with utility companies or verify that utilities have been shut off.
- T. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless authorized in writing by the Owner, and then only after arranging to provide temporary utility services according to requirements indicated.
- U. Coordinate utility interruptions with utility company affected.
- V. Do not proceed with utility interruptions without the permission of the Owner and utility company affected. Notify Owner and utility company affected two working days prior to utility interruptions.
- W. Excavate and remove underground utilities that are indicated to be removed.
- X. Securely close ends of abandoned piping with tight fitting plug or wall of concrete minimum 6-inches thick.

2.3 SITE IMPROVEMENTS

- Y. Remove existing above- and below-grade improvements as indicated and as necessary to facilitate new construction.
- Z. Remove slabs, paving, curbs, and gutters, as indicated. Where concrete slabs, curb, gutter and asphalt pavements are designated to be removed, remove bases and subbase to surface of underlying, undisturbed soil.
- AA. Unless the existing full-depth joints coincide with line of pavement demolition, neatly saw-cut to full depth the length of existing pavement to remain before removing existing pavement. Saw-cut faces vertically.
- BB. Remove driveways, curbs, gutters and sidewalks by saw cutting to full depth. If saw cut falls within 30-inches of a construction joint, expansions joint, score mark or edge, remove material to joint, mark or edge.

2.4 BACKFILL

- CC. Place and compact material in excavations and depressions remaining after site clearing in conformance with Section 312300 Excavation and Fill.

2.5 DISPOSAL

- DD. Remove surplus obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off the Owner's property.

END OF SECTION

SECTION 030000 CONCRETE

SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete
 - 2. Concrete accessories for cast-in-place concrete.
 - 3. Embedded items
 - 4. Unbonded post-tensioned concrete

1.2 REFERENCES

- A. ACI 117 – Specification for Tolerances for Concrete Construction and Materials
- B. ACI 214 - Recommended Practice for Evaluation of Strength Test Results of Concrete.
- C. ACI 301 - Specifications for Structural Concrete for Buildings.
- D. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
- E. ACI 305 - Hot Weather Concreting.
- F. ACI 306 - Cold Weather Concreting.
- G. ACI 309 - Guide for Consolidation of Concrete.
- H. ACI 318 - Building Code Requirements for Structural Concrete.

1.3 CAST-IN-PLACE CONCRETE

- A. Normal Weight Concrete Quality:
 - 1. Slab on Grade shall have a maximum water-to-cement ratio of 0.45, and a minimum concrete compressive strength of 4000 psi at 28 days.
 - 2. Elevated Post-Tensioned Decks, and beams shall have a minimum concrete compressive strength of 5000 psi at 28 days, with a compressive strength of 2750 psi at 3 days.
 - a. A low shrinkage concrete mix aggregate shall be used with a 21 day total dry shrinkage after initial 7 day wet cure period and shall not be greater than 0.045% in laboratory condition and 0.055% in field condition. Testing shall be based on ASTM C157 and as modified by SEAONC's "Supplementary Recommendations for Control of Shrinkage in Concrete". Representative concrete mixes with shrinkage tests may be used to establish the shrinkage characteristics of the mix with the same aggregates, type of cement, and admixtures. Representative concrete mixes shall be based on a minimum of three laboratory trial batches or three field sampled concrete. If representative concrete mix test results are not available, testing specific for this project is required prior to start of construction.
 - 3. Foundations shall have a minimum concrete compressive strength of 3000 psi at 28 days.

1.4 FINISHING

- A. (CONC FIN-1) Hard Trowel Finish:
 - 1. Follow General Finishing Requirements for initial procedures.
 - 2. Restraighten surface if required following paste-generating float passes using 10-foot wide highway straightedge. Apply in two directions at 45 degree angle to strip. Use supplementary material to fill low spots.
 - 3. Consolidate concrete surface, uniform in texture and appearance, with three or more passes using power trowel. Hand trowel areas inaccessible by power trowel.
 - 4. Grind smooth any surface defects that would telegraph through applied floor covering system.
- B. (CONC FIN-2) Non-Slip Broom Finish:

1. Follow General Finishing Requirements for initial procedures.
 2. While still plastic, slightly roughen concrete surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.
- C. (CONC FIN-6) Float Finish:
1. Utilize wet-screed guides, dry-screed guides, and/or edge forms for initial strikeoff set with optical or laser instruments as appropriate to attain specified Floor Profile Number. Check elevation after initial strikeoff and repeat as necessary.
 2. Smooth and restraighten surface using 8 to 10 foot wide bull float, darby, or modified highway straightedge.
 - a. Apply in two directions at 45 degree angle to strip for Overall Floor Flatness, F_F30 or greater.
 3. Wait until bleed water sheen has disappeared and concrete can sustain finishing operations employed without digging in or disrupting the levelness of the surface.
 4. Float surface with one or more passes using a power float (float shoe blades or pans) or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.
 5. Uniformly slope surfaces to drains.
- D. (CONC FIN-20) Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defective areas. Remove fins and other projections exceeding 1/8 inch amplitude.
1. Apply to concrete surfaces exposed to public view or to be covered with a coating or covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, or painting.

1.5 CONCRETE ACCESSORIES

- A. Under Slab Vapor Retarder (UVB) - ASTM E 1745, Class A. Permeance of less than 0.01 perms before and after mandatory conditioning tests per ASTM E 1745, Sections 7.1.1 – 7.1.5.
1. Minimum Thickness, ACI 302: 15-mil
 2. Nonwoven, polyester-reinforced, polyethylene coated sheet
 3. Three-ply, nylon or polyester-cord-reinforced, laminated, high-density polyethylene sheet
 4. Maximum Water Vapor Permeance, ASTM E 154: 0.01 perms
 5. Minimum Tensile Strength, ASTM E 154: 45 lbf/in.
 6. Puncture Resistance, ASTM D 1709: 2200 grams
- B. Embedded Items: Material to be embedded in concrete shall comply with the following requirements:
1. Conduits and pipes, and their fittings, embedded in columns and shall not displace more than 4 percent of the area of cross section on which strength is calculated or is required for fire protection.
 2. They shall not be larger in outside diameter than 1/3 the overall thickness of slab, wall, or beam in which they are embedded, and shall be placed in the center of 2 layers of reinforcement.
 3. They shall not be spaced closer than 3 diameters or width on center.
 4. No gas, liquid, or vapor, except water not exceeding 90o F and also 50 psi pressure, shall be placed in pipes until the concrete has attained its design strength. All pipes shall be tested prior to placing concrete.
 5. Embedded Aluminum: Conduits, pipes, and sleeves of aluminum shall not be embedded in structural concrete unless effectively coated or covered to prevent aluminum-concrete reaction or electrolytic action between aluminum and steel.
- C. Curing and Sealing Compounds (CS): Comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

1. Curing compound and areas to receive compound must be approved by Owner prior to placement.
2. For concrete to receive finish materials curing compound must be free of silicate solutions (no exceptions) and compatible with the finishing materials.
3. (CS) Clear, Non-residual, Waterborne, Membrane-Forming Curing Compound: Apply in accordance with manufacturer's recommendations and at coverage rate meeting ASTM C 309, Type 1, Class B, 18 to 22 percent solids. To be used at contractor's option in lieu of moist cure, in accordance with ACI 301, for floors to receive tile work, toppings, liquid applied waterproofing, synthetic flooring or other surface treatments for which bonding could be impaired by surface residue.

1.6 ADDITIONAL REQUIREMENTS

- A. Slab Reinforcing: For slab-on-grades use a minimum of #4 reinforcing bars at 18-inches on center each way near the top of the slab. Welded wire fabric is not acceptable. Provide adequate control joints and construction joints in slab to control drying-shrinkage cracks. Other additional crack control mitigation measures shall be considered and communicated on the construction documents as determined necessary for exposed concrete floors.
- B. Floor Flatness and Levelness: Finish surfaces to tolerances of FF35 (floor flatness) and FL25 (floor levelness) for overall number and tolerances of FF25 (floor flatness) and FL18 (floor levelness) for local test areas, measured according to ASTM E 1155. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to uniform, smooth, granular texture. Measure Floor Profile Numbers within 72 hours of final finishing operations and prior to removal of forms on elevated slabs for each slab placement. Report deficient areas to Architect of Record to determine repair procedures appropriate for final required finish.
- C. Make appropriate adjustments to construction procedures prior to next slab placement when previous slab placement is deficient.
- D. Floor Levelness (FL), tolerances only apply to non-sloping slabs-on-grade and suspended slabs shored at time of testing. Floor Levelness tolerances shall not apply to slabs placed on unshored form surfaces, shored surfaces after removal of shores, or pitched slab surfaces per ACI 302.
- E. Cementitious Materials: Use Type F fly ash to replace the total amount of cement which would otherwise be used, but not less than 18%, for all mix design.

1.7 QUALITY ASSURANCE

- A. Testing During Construction: Sample of strength tests of each class of concrete placed each day shall be taken not less than ²once a day, nor less than once for each 150 yards of concrete, nor less than once for each 5,000 ft² of surface area (one side only) for slab or walls. If total volume of concrete is such that frequency of testing required would provide less than five strength tests for a given class of concrete, tests shall be made from at least five randomly selected batches or from each batch if fewer than five batches are used.
- B. At the beginning of the concrete work or whenever the mix or aggregate is changed, additional samples for 7-day compressive strength tests shall be taken for each class of concrete.

1.8 LEED REQUIREMENTS

- A. Recycled Content of Steel Products: Provide steel products to maximize recycled content so postconsumer recycled content plus one-half of pre-consumer recycled content contributes to overall recycled content of 20% minimum for the entire building. Steel recycled content of 80% or higher is common
- B. Regional Materials: Provide concrete that is manufactured within 500 miles of Project site, made from aggregates and cementitious materials that have been extracted, harvested, or recovered, as well as manufactured within 500 miles of Project site.

1.9 UNBONDED POST-TENSIONED CONCRETE

1.10 REFERENCES

- A. ACI 301- Specifications for Structural Concrete.
- B. ACI 318/R- Building Code Requirements for Structural Concrete and Commentary.
- C. ACI 423.3R- Recommendations for Concrete Members Prestressed with Unbonded Tendons.
- D. ACI 423.6/R Specification for Unbonded Single-Strand Tendons and Commentary.
- E. ASTM A416- Standard Specification for Steel Strand, Uncoated Seven-Wire Low-Relaxation Strand for Prestressed Concrete.
- F. Post-Tensioning Manual; Post-Tensioning Institute.
- G. Field Procedures Manual For Unbonded Single Strand Tendons; Post-tensioning Institute.

1.11 PRESTRESSING TENDONS

- A. Prestressing Strand: ASTM A 416, Grade 270, uncoated, 7-wire, low-relaxation, 0.5 inch diameter strand.
 - 1. Post-Tensioning Coating: Compound with friction-reducing, moisture-displacing, and corrosion-inhibiting properties specified in ACI 423.6; chemically stable and nonreactive with prestressing steel, nonprestressed reinforcement, sheathing material, and concrete.
 - 2. Minimum Coating Weight: 2.5 lb per 100 feet of strand for 0.5 inch diameter strand. Completely fill annular space between strand and sheathing over entire tendon length with post-tensioning coating.
 - 3. Completely fill interstices between individual wires of strand.
- B. Tendon Sheathing: Comply with ACI 423.6.
 - 1. Minimum Thickness: 0.05 inch for polyethylene or polypropylene with a minimum density of 0.034 lb/cu. in.
 - 2. Continuous and electrically isolated over the entire length of tendon to provide watertight encapsulation of strand and anchor.
 - 3. Continuous over the entire length of tendon between anchorages to prevent intrusion of cement paste or loss of coating for a non-encapsulated system.
 - 4. Tendon sheathing color shall contrast with color of coating material such that tears to the sheathing are easily detectable. Black and brown sheathing are unacceptable.
- C. Anchorage Device and Coupler Assembly: Assembly of strand, wedges, and anchorage device or coupler complying with static and fatigue testing requirements in ACI 423.6 and capable of developing 95 percent of actual breaking strength of strand.

1.12 COORDINATION

- A. Other trades embedding or attaching work to post-tensioned concrete shall thoroughly coordinate installation of their work and submit detailed shop drawings of installations including attachments, sleeves, embedded conduit, and blockouts for review and incorporation with tendon installation drawings.
 - 1. Embedded work of any type shall not interfere with location and profile of post-tensioning tendons.
 - 2. Length of continuous inserts shall not exceed 3 feet unless specifically coordinated with post-tensioning tendon shop drawings and approved.
 - 3. Sleeve penetrations through beams are not permitted unless explicitly shown on Drawings or authorized in writing by Architect/Engineer.
- B. Attachments and Penetrations:

1. Attach permanent fixtures such as curtain-wall systems, precast wall panels, handrails, fire-protection equipment, lights, and security devices to the slab using embedded anchors.
 2. Drilled anchors are not permitted.
 3. Power-driven fasteners exceeding 1 inch in length are not allowed unless authorized in writing by Architect/Engineer.
 4. Core drilling for sleeves or other penetrations is not permitted.
 5. Trim penetrations with additional nonprestressed reinforcement as shown in Drawings.
 6. Protect penetrations adjacent to an anchorage with steel pipe as shown in Drawings. Provide galvanized pipe in exterior applications exposed to weather.
- C. Embedded Conduit: Plastic and/or metal conduit may be embedded in post-tensioned slabs provided the following conditions are met or authorized by Architect/Engineer in writing:
1. Maximum conduit outside diameter = $1/5$ slab thickness, but not greater than 1.50 inches.
 2. Conduits are to be located in middle third of slab thickness.
 3. Maximum of two crossing conduits at any location.
 4. Maximum number of conduits in a group = 4
 5. Minimum clear spacing between conduits = 4 times conduit outside diameter, but not less than 4 inches.
 6. Minimum space between adjacent conduit groups = 24 inches.
 7. Maximum total number of conduits within a 5 foot width of slab = 8.
 8. Conduits running perpendicular to nonprestressed reinforcement may be tied to the nonprestressed reinforcement. Conduit running parallel to nonprestressed reinforcement must independently supported on chairs and support bars supplied by the electrical contractor. Conduits must not displace nonprestressed reinforcement.
 9. Conduits are not permitted to be anchored or tied to post-tensioning tendons.
 10. Aluminum conduit is not permitted.

1.13 EXECUTION

- A. Tendons shall be secured to a sufficient number of supported bars or slab bolsters to maintain the profile of the tendons during the placement of concrete. The maximum spacing between supporting elements shall not exceed 42 inches. Chairs shall be stapled to the forms.
- B. Support bars shall be #4 or greater, except #6 support bars are required at the face of drop caps. When drop cap widths exceed 4 feet, an additional #6 support bar is required at the center of the drop cap.
- C. Contractor shall take care to properly consolidate concrete at the tendon anchors and over drop caps. At drop caps it is required to fill below the mat of top reinforcement before placing concrete on top to the specified concrete thickness and cover.
- D. During placement concrete hoses shall not be permitted to ride or be dragged over the tendons.
- E. Do not burn-off tendon ends until field readings of tendon elongations and/or stressing forces are within plus or minus 5 percent of the calculated values. After satisfactorily stressing the slab, within one week the tendon ends shall be burned off and grease caps installed. Immediately following the recess shall be filled non-shrink grout.

END OF SECTION

SECTION 047210 STONE VENEER WALL

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide all labor, materials, equipment and services required for and incidental to the installation of stone veneer walls using natural stone.

1.2 RELATED WORK

- 1. Procedures and requirements for managing and disposing construction and demolition waste: Section 017419, CONSTRUCTION WASTE MANAGEMENT.
- A. Section 321320, SITE CONCRETE

1.3 QUALITY ASSURANCE

- A. Pre-installation Conference: Conduct conference at Project site with Resident Engineer.
- 1. Stone samples for comparison of quality and color are available from the Landscape Architect or Contracting Officer. Contractor shall request access to these samples for review, prior to submitting samples for approval.
- 2. Preconstruction Soil Testing: Engage a qualified independent testing agency to test soil reinforcement and backfill materials for compliance with design criteria.
- 3. Installer Qualifications: Firm specializing in design and installation of stone walls and :
 - 1. With not less than 2 years documented experience.
 - 2. With a minimum of five previously constructed successful projects, similar in size and magnitude, using specified wall system; Provide contact names and numbers.
 - 3. Site supervisor with verifiable qualified experience suitable for this project.

1.4 SUBMITTALS

- A. Samples:
 - 1. Stone, samples 3 by 6 by 12 inches, each color and finish.
- 1. Shop Drawings:
 - 2. Stone walls showing exposed faces, profiles, cross sections, anchorage, reinforcing, jointing and sizes.
- 2. List of jobs furnished by the manufacturer, which were similar in scope and at least three (3) years of age.
- 3. Mockups: Build 8' long sample curb mockup including veneer over prepared, tested and approved concrete wall core to verify selections made under sample submittals and to demonstrate functional and aesthetic effects and set quality standards for materials and execution. Mockup should include color range, texture, bond pattern, and joints. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion. Do not continue masonry work until mock-up has been approved by Resident Engineer.

1.5 PRODUCT DELIVERY, STORAGE AND HANDLING

- A. Store cement, sand, Lime and stone under waterproof covers on planking clear of ground.
- 1. Protect Stone from handling, dirt, stain, and water damage.

1.6 WARRANTY

- A. Warranty exterior masonry walls against moisture leaks, any defects and subject to terms of "Warranty of Construction", FAR clause 52.246-21, except that warranty period shall be two years.

1.7 APPLICABLE PUBLICATIONS

- A. Publications listed below form a part of this specification to extent referenced. Publications are referenced in text by the basic designation only. Comply with applicable provisions and recommendations of the following, except as otherwise shown or specified.
 - 1. Concrete Reinforcing Steel Institute (CRSI): "Manual of Standard Practice" and "Recommended Practice for Placing Reinforcing Bars".
 - 2. California Code of Regulations, Title 24, 2007 Edition, also known as California Building Code (CBC).
 - 3. American Society for Testing and Materials (ASTM):
 - 1. A167-99 (2004) Stainless and Heat Resisting Chromium- Nickel Steel Plate, Sheet, and Strip
 - 2. A185-07 Steel, Welded Wire Fabric, Plain for Concrete
 - 3. A615/A615M-08 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 4. C33-07 Concrete Aggregates
 - 5. C150-07 Portland Cement
 - 6. C503-08 Marble Dimension Stone (Exterior)
 - 7. C568-08 Limestone Dimension Stone
 - 8. C615-03 Granite Dimension Stone
 - 9. C616-08 Quartz-Based Dimension Stone
 - 10. C979-05 Pigments for Integrally Colored Concrete

PART 2 PRODUCTS

2.1 PORTLAND CEMENT

- A. ASTM C150, TYPE I.

2.2 SAND

- A. ASTM C144; natural sand containing not more than 2% of silt and clay by weight with specific gravity not less than 2.65.

2.3 LIME:

- A. ASTM C5, slake; screen through 16 mesh, then store and protect for 10 days.

2.4 STONE VENEER WALL SOLID STONE UNITS

- A. Natural stone quarried and sawn (except for face) into rectangular shapes and sizes suitable for the wall configuration as shown.
 - 1. Stone Type: Per Plans
 - 2. Corners shall be prefabricated corner sets with alternating lapped corner pieces.
 - 3. Top cap pieces shall all be of the same stone material as veneer stone. All top cap pieces shall be a consistent color. Sawn and flamed finish on top face. Natural hewn finish on front, back, and side faces. Size as shown in drawings.
- 1. Concrete Wall Core and Foundation: Reinforced concrete with compressive strength of 3,000 psi minimum.
- 2. Drainage backfill: Class 2 permeable backfill per Caltrans with Subsurface Drain system as described herein.

2.5 MORTAR:

- A. Consist Of 1 Part Portland Cement And 4 Parts Dry, Loose Sand. Add Not Less Than 1/4 Nor More Than 1/2 Part Lime Putty Or Hydrated Lime Per Volume Of Cement Content. Insure Mortar With 28-Day Strength Of At Least 1500 Psi.

2.6 GROUT:

- A. Consist of 1 part portland cement and 3 parts sand. Add up to 10% lime. When the grout core is 2" or more wide, add 2 parts of pea gravel to the above grout mix. Add water to grout to cause it to flow without segregation into all voids intended to be filled, and to produce a 28-day strength of 2000 PSI. Plaster sand may be added to prevent segregation, provided strength is maintained. Color: medium to light gray color added to mortar. Submit color samples for acceptance by resident engineer.

2.7 REINFORCING MATERIALS

- A. All anchors, dowels and other anchoring devices and shims shall be standard building stone anchors commercially available in a non-corrosive material such as zinc plated, galvanized steel, brass, or stainless steel Type 302 or 304.

2.8 ANCILLARY MATERIALS

- A. Dampproofing: Per CALTRANS Standard Specifications, Section 54.
- B. Subsurface Drain behind Retaining-Type Walls: All walls that retain 30 inches of soil or more shall include a subsurface drainage system to relieve water pressure in accordance with Section 68 of the CALTRANS Standard Specifications and as shown. If no subsurface drain is shown, provide corrugated polyethylene plastic tubing per 68-1.02K surrounded with an envelope of Class 2 permeable material per 68-1.025 and wrapped with filter fabric per 68-1.028. Connect drains to storm drain system as accepted by Resident Engineer.
- C. Caulk for dowel anchors shall be a one-part, cold-applied, non-sagging silicone material that cures to a medium modulus silicone rubber upon exposure to atmospheric moisture.

PART 3 EXECUTION

3.0 PREPARATION

- A. Provide testing and subgrade preparation complete.
- B. Provide subgrade preparation and the base material installation complete, including clearing, grading, excavation, filling and dewatering. Take every precaution to obtain a subgrade of uniform bearing power compacted to a minimum of 95% relative compaction as determined by the ASTM D1557 laboratory test procedure and in Sections 19 and 20 of the Caltrans Standard Specifications.
- C. Do any necessary finish grading and compaction in addition to that performed in accordance with earthwork to bring subgrades after final compaction to required grades and sections as indicated. Place no material on muddy subgrade. Remove un-compactable material and replace with clean fill and compact as required.
- D. Excavate to lines and grades shown on Drawings. Do not disturb embankment or foundation beyond lines. Minimize over-excavation.
- E. After excavation and prior to placement of leveling materials, Contractor's Geotechnical engineer shall examine bearing soil surface to verify strength meets or exceeds design requirement and assumptions and issue report to Resident Engineer for acceptance. Replace any unsuitable bearing soil as directed by Geotechnical Engineer.

3.1 REINFORCEMENT

- A. Concrete wall and footing shall be steel reinforced.

3.2 INSTALLATION

- A. Install in accordance with Drawings and applicable codes and regulations.
 - 1. Erection Tolerances:
 - a. Variation for plane may be 1/4".
 - 2. Mortar joints as shown on drawings. Recess mortar joints minimum 3/4" inch. Provide pitch on horizontal joints to drain. Strike all joints to provide dense mortar.
 - 3. Place first course of units on concrete foundation; check alignment and level. Check for full contact with base and for stability.
 - 4. Place units side by side aligning face of wall using string line or offset from base line.
 - 5. Insert anchoring devices as required. Check for proper alignment and batter. Place succeeding courses.
- 1. Setting Stones:
 - 1. Distribute stones as shown on drawings. Brush free of dust or other foreign matter and thoroughly wet before placing. Set in full mortar beds.
 - 6. Provide sufficient number of stones to install complete wall from lines and grades shown on the drawings and details.

3.3 DAMPPROOFING

- A. Mop apply one heavy coat of asphalt to a minus 2 inches below finished soil grade on soil side of retaining wall.

3.4 CONSTRUCTION WASTE MANAGEMENT

- A. General: Comply with Contractor's Waste Management Plan and Section 017419, CONSTRUCTION WASTE MANAGEMENT.
- B. To the greatest extent possible, separate reusable and recyclable products from contaminated waste and debris in accordance with the Contractor's Waste Management Plan. Place recyclable and reusable products in designated containers and protect from moisture and contamination.

3.5 CLEANUP:

- A. Exercise care that no mortar or grout comes in contact with exposed face of work. Clean immediately.
- B. Use only stiff fiber brushed and wooden scrapers in keeping work clean as it progresses or in cleaning down at completion. Use no metal implements

END OF SECTION

SECTION 050000 METALS

SYSTEM DESCRIPTION

- A. Structural Steel shall comply with applicable provisions of the specifications and documents listed in section.
- B. Cold-Formed Metal Framing shall comply with AISI Specifications and Standards, AISI S100 and AISI S200. Steel Sheet for Cold-Formed Framing Components: ASTM A 1003, Structural Grade 33 Type H (ST33H), with ASTM A 653 G90 zinc coating.
- C. Primer: Lead- and chromate-free, non-asphaltic, rust-inhibiting primer that is compatible with topcoat, and in compliance with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical
- D. Corrosion Protection
 - 1. Exterior Metal and Metal Exposed to Moisture: Provide non-ferrous metal, hot-dipped galvanized or a high performance paint system consisting of one coat of a zinc rich epoxy primer and two coats of enamel finish. Primer and finish coats shall be produced by the same manufacturer.
 - 2. Interior Metal: Provide prime-painted, 2 mil minimum dry-film thickness, using lead- and chromate-free, non-asphaltic, rust-inhibiting primer that is compatible with topcoat, and in compliance with testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
 - 3. Extent: Structural steel surfaces, including surfaces concealed by interior building finish. Do not shop prime the following structural steel surfaces:
 - a. Surfaces embedded in concrete or mortar.
 - b. Surfaces to be field welded.
 - c. Surfaces to be high-strength bolted with slip-critical connections.
 - d. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - e. Galvanized surfaces.

QUALITY ASSURANCE

- A. Markings: Identify structural steel according to ASTM A6 - Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling and maintain markings until structural steel has been erected. Mark and match-mark materials for field assembly. Use of materials without particular specification, under a specification that is less rigorous than the applicable ASTM specifications or without certified mill test is not permitted.

FRAMING MATERIALS

- A. (STL STUD) Structural Steel Studs: ASTM A653, structural steel, zinc coated, with the following properties:
 - 1. Yield Stress: 33 ksi minimum.
 - 2. Coating: G90.
 - 3. Shape: ASTM C955, manufacturer's standard "C".
 - a. Type: Punched with stiffened flanges.
 - b. Web Depth: 6 inches minimum.

- 1) Other sizes where indicated.
 - c. Minimum Flange Width: 1-5/8 inches.
 - 4. Minimum Uncoated-Steel Thickness: 0.0538 inch (16 gauge).
- B. Steel Furring: ASTM A653, structural steel, zinc coated, with the follows properties:
- 1. (STL FURG-1) Hat Shaped, Rigid Furring Channels: ASTM C645, base metal 0.0428 inch (18 gauge) thick.
 - a. Thickness: 7/8 inch.
 - 2. (STL FURG-2) "Z" furring
 - a. Yield Stress: 33 ksi.
 - b. Coating: G90.
 - c. Shape: ASTM C955, manufacturer's standard "Z".
 - 1) Type: Punched with stiffened flanges.
 - 2) Depth: 2 inches.
 - (a) Other sizes where indicated.
 - 3) Spacing: As indicated
 - d. Minimum Uncoated-Steel Thickness: 0.0329 inch (20 gauge).
 - e. Depth to match insulation thickness as shown.

EXTEROR GYPSUM SHEATHING

- A. (GYP SHTG) Glass Face Gypsum Sheathing: High-moisture resistant board with water-resistant silicone or wax treated gypsum core and fiberglass reinforced faces manufactured in accordance with ASTM C1177 specially designed for exterior substrate.
- 1. Thickness: 5/8 inch thick, Type X.
 - 2. Size: Manufacturer's standard

END OF SECTION

SECTION 051213
ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. General: Provide architecturally exposed structural steel framing in accordance with requirements of the Contract Documents.
- B. Section includes architecturally exposed structural-steel framing.
 - 1. Requirements in Division 05 Section "Metals - Structural" also apply to AESS framing.
- C. Related Sections:
 - 1. Division 01 Section "Quality Control" for independent testing agency procedures and administrative requirements.
 - 2. Division 05 Section "Metals - Structural" for additional requirements applicable to AESS.
 - 3. Division 05 Section "Metal Fabrications" for miscellaneous steel fabrications and other metal items not defined as structural steel.

1.2 DEFINITIONS

- A. Architecturally Exposed Structural Steel: Structural steel designated as "architecturally exposed structural steel" or "AESS" in the Contract Documents.
- B. (AESS-1) Category 1 AESS: AESS that is within 96 inches vertically and 36 inches horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 1 architecturally exposed structural steel" or "AESS-1" in the Contract Documents.
- C. (AESS-2) Category 2 AESS: AESS that is within 20 feet vertically and horizontally of a walking surface and is visible to a person standing on that walking surface or is designated as "Category 2 architecturally exposed structural steel" or "AESS-2" in the Contract Documents.
- D. (AESS-3) Category 3 AESS: AESS that is not defined as Category 1 or Category 2 or that is designated as "Category 3 architecturally exposed structural steel" or "AESS-3" in the Contract Documents.

1.3 PERFORMANCE REQUIREMENTS

- A. Performance Criteria: Architecturally exposed structural steel, serves as a support for the exterior walls and is subject to compliance with performance criteria shown and specified for the exterior walls. Coordinate with performance criteria on drawings, or specified in Division 08, exterior wall sections as required to provide a complete installation complying with performance criteria.
- B. Design of Members and Connections: Details shown are typical and apply to similar conditions, unless otherwise indicated. Verify dimensions at the site without causing a delay in the work. Dimensions are shown based on an assumed design temperature of 70 deg. F. Fabrication and erection procedures shall take into account the ambient temperature range at the time of the respective operations.

1.4 ACTION SUBMITTALS

- A. Product Data: Submit product data or manufacturer's specifications and installation instructions for each type of product indicated, including finishing materials, and:

1. High-strength bolts (each type), including nuts and washers.
 - a. Include Direct Tension Indicators if used.
 2. Structural steel primer and finish paint systems. Submit paint manufacturer's certification that specified paint will achieve required slip coefficient for friction type connections and complies with referenced standards.
 3. Shrinkage-resistant grout.
- B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS provided items of AESS are specifically identified and requirements below are met for AESS.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical high-strength bolted connections. Indicate orientation of bolt heads.
 4. Indicate exposed surfaces and edges and surface preparation being used.
 5. Indicate special tolerances and erection requirements.
- C. Samples: Submit samples of AESS to set quality standards for exposed welds for Category 1 AESS.
1. Two steel plates, 3/8 by 8 by 4 inches, with long edges joined by a groove weld and with weld ground smooth.
 2. Steel plate, 3/8 by 8 by 8 inches, with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches, welded to plate with a continuous fillet weld and with weld ground smooth and blended.
 3. Round steel tube or pipe, minimum 8 inches in diameter, with end of another round steel tube or pipe, approximately 4 inches in diameter, welded to its side at a 45-degree angle with a continuous fillet weld and with weld ground smooth and blended.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer and fabricator.
- B. Reports
1. Submit certified copies of mill test reports for all steel furnished. Perform mechanical and chemical tests for all material regardless of thickness or use. No part of the ASTM Specifications will be waived without written consent of the Architect.
 2. Submit copies of prequalified and other welding procedures in form prescribed in "Structural Welding Code".
- C. Maintenance Manual: Submit maintenance manuals describing the materials, devices and procedures to be followed in cleaning and maintaining Architecturally exposed steel or use during construction and for use by the Owner after acceptance of the Work. Include manufacturer's data describing the actual materials, finishes and all other major components used in the Work.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
- B. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.
- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."
- D. Reference Standards: Except as modified by governing codes and by the Contract Documents, comply with the applicable provisions and recommendations of the following:
 - 1. AISC "Specification for the Design, Fabrication and Erection of Structural Steel for Buildings" (including all supplements).
 - 2. AISC "Specification for Architecturally Exposed Structural Steel".
 - 3. AISC "Code of Standard Practice for Steel Buildings and Bridges
 - 4. Industrial Fasteners Institute "Fastener Standards Book".
 - 5. AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".
 - 6. AWS D1.1 "Structural Welding Code".
 - 7. SSPC "Steel Structures Painting Manual, Volume 2, Systems and Specifications".
 - 8. Where the language in any of the documents referred to herein is in the form of a recommendation or suggestion, such recommendations or suggestions shall be deemed to be mandatory under this Contract.
- E. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.
 - 1. Build mockup of typical portion of AESS as shown on Drawings.
 - 2. Mock-ups shall be representative of the finished work in all respects. Apply finished paint system specified herein to all surfaces of mock-ups. Touch-up mock-ups as required.
 - 3. Coordinate finish painting requirements with Division 09 painting Sections.
 - 4. Replace unsatisfactory work as directed until final acceptance by the Architect. Maintain accepted mock-ups throughout Project construction. Mock-up assemblies will be used as a standard for judging acceptability of Work on the Project.
 - 5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- F. Preinstallation Conference: Conduct conference at Project site
 - 1. Meet at the Project Site to review installation and coordination procedures. Among other topics, the coordination meeting shall address scheduling, preparation of surfaces contiguous with this work, adjacent construction, and interferences, if any. This meeting shall be attended by any and all trades, manufacturer's representatives, and other interested parties whose work will be affected by the execution of the work under this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Do not handle Architecturally exposed structural steel until paint has thoroughly dried. Care shall be exercised to avoid abrasions and other damage.

- B. Use special care in handling to prevent twisting, warping, nicking, and other damage. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.
 - 1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Where AECS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

1.9 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' recommendations to ensure that shop primers and topcoats are compatible with one another.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Recycled Content: Provide architecturally exposed structural steel with the following recycled content:
 - B. Wide Flange Beams and Built-Up Sections with an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 75 percent.
 - C. Steel Tubing and hollow steel sections an average recycled content of steel products so postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.
- D. Architecturally Exposed Structural Steel: ASTM A36 unless otherwise shown.
- E. Steel Tubing: ASTM A500, Grade B.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain Mechanically deposited zinc coating
 - 2. All connectors should match steel painting in final form..
- B. Corrosion-Resisting (Weathering Steel), Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 3, round-head assemblies, consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
- C. High-Strength Bolts and Nuts: ASTM A325 and ASTM A490, of the type and profile shown.
- D. Direct Tension Indicators: ASTM F959, type as required.
 - 1. Use on all A325 and A490 bolts.

- E. Cap Nuts: Compatible material, finish and threads with specified high strength bolts and nuts of profile as shown.
- F. Filler Metal:
 - 1. Electrodes for Carbon Steel: Conform to "Structural Welding Code".
- G. Anchor Bolts: ASTM A307 Grade A, hot dip galvanized in accordance with A153, Class C, nonheaded type unless otherwise indicated.
 - 1. Maximum allowable VOC for field applied adhesive use with steel anchors in masonry substrates shall be 50 grams/liter.

2.3 PRIMER

- A. Universal Primer for Weld Through: "Carbocoat 150" (Carboline); 2-3 mils d.f.t.
- B. Shop Primer For All Steel Not Otherwise Specified: If exposed, compatible with the finish coats of paint.
- C. Milled Surfaces: Light oil coating or strippable protective coating: apply as per AISC requirements prior to shipment.
- D. Architecturally Exposed Steel: Provide the following:
 - 1. Zinc rich primer in a crosslinked epoxy or organic resin.
 - 2. Final Coat: Compatible with, and of the same manufacturer as, the primer. Provide the respective dry film thickness specified; satin finish coat.
- E. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- F. Galvanizing Repair Paint: ASTM A 780.
 - 1. The maximum allowable VOC content for field applied galvanizing repair paint shall be 250 grams/liter.

2.4 MISCELLANEOUS MATERIALS

- A. Sliding Bearing Pads: Provide factory assembled, permanently identified, fixed rotational or expansion rotational bearing pads having sliding surfaces of TFE against stainless steel mating surfaces providing for rotation in all directions and sliding in directions as shown, including all directly connected or welded anchorages. Provide pads centerlines marked both on top and base plates to allow for alignment in the field.
- B. Non-metallic Shrinkage Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining, shrinkage resistant product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621 and ASTM C1107, free of gas-producing or gas-releasing agents, oxidizing catalysts, inorganic accelerators and chlorides.

2.5 FABRICATION

- A. Shop fabricate and assemble AECS to the maximum extent possible. Fabricate items of Architecturally exposed structural steel in accordance with AISC Specifications and as indicated on final shop drawings. Provide camber in structural members where indicated. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

1. Properly mark and match-mark materials for field assembly. Fabricate for delivery sequence that will expedite erection and minimize field handling of materials.
 2. Where finishing is required, complete assembly, including welding of units, before start of finishing operations. Provide finish surfaces of members exposed in final structure free of markings, burrs, and other defects.
- B. Architecturally exposed structural steel members including built-up members shall conform to the tolerance requirements specified in "Specifications for Architecturally Exposed Structural Steel". Correct damaged members to meet the above referenced specification. Grind abrasions and other defects where finished appearance will be affected.
- C. In addition to special care used to handle and fabricate AESS, comply with the following:
1. Fabricate with exposed surfaces smooth, square, and free of surface blemishes including pitting, rust, scale, and roughness.
 2. Grind sheared, punched, and flame-cut edges of Category 1 AESS to remove burrs and provide smooth surfaces and edges.
 3. Fabricate Category 1 AESS with exposed surfaces free of mill marks, including rolled trade names and stamped or raised identification.
 4. Fabricate Category 1 and Category 2 AESS with exposed surfaces free of seams to maximum extent possible.
 5. Remove blemishes by filling or grinding or by welding and grinding, before cleaning, treating, and shop priming.
 6. Fabricate with piece marks fully hidden in the completed structure or made with media that permits full removal after erection.
 7. Fabricate Category 1 AESS to the tolerances specified in AISC 303 for steel that is designated AESS.
 8. Fabricate Category 2 and Category 3 AESS to the tolerances specified in AISC 303 for steel that is not designated AESS.
 9. Seal-weld open ends of hollow structural sections with 3/8-inch closure plates for Category 1 AESS.
- D. Curved Members: Fabricate indicated members to curved shape by rolling to final shape in fabrication shop.
1. Distortion of webs, stems, outstanding flanges, and legs of angles shall not be visible from a distance of 20 feet under any lighting conditions.
 2. Tolerances for walls of hollow steel sections after rolling shall be approximately 1/2 inch.
- E. Coping, Blocking, and Joint Gaps: Maintain uniform gaps of 1/8 inch with a tolerance of 1/32 inch for Category 1 AESS.
- F. Bolt Holes: Cut, drill, , or punch standard bolt holes perpendicular to metal surfaces not more than 1/16 in. larger than the connector diameter. Do not make or enlarge holes by burning. Drill material having a thickness in excess of the connector diameter and material thicker than 7/8 in. Holes shall be clean-cut without torn or ragged edges. Remove outside burrs resulting from drilling operations.
- G. Fill dents in architecturally exposed structural steel with metallic filler and grind flush and smooth.
- H. Cleaning Corrosion-Resisting Structural Steel: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel framing members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Provide holes in members to permit connection of the work of other trades. Use suitable templates for proper location of these holes. Steel requiring adjustment shall be provided with slotted holes
3. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
4. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Slip critical, Class A or B as indicated.
 2. Use high-strength bolts in bearing and/or friction as shown. Make high-strength bolted joints without the use of erection bolts. Bring members tightly together with sufficient high-strength "fitting-up" bolts which shall be retightened as all the bolts are finally tightened. Manual torque wrenches will not be accepted for final tightening. Protect bolt heads from damage during placing. Bolts that have been completely tightened shall be marked for identification. Provide cap nuts where shown or specified.
 3. Final tightening of high-strength bolts shall be by properly calibrated wrenches unless turn-of-nut method is specifically permitted. Each wrench shall be checked for accuracy at least once daily.
- B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work, and comply with the following:
 1. Assemble and weld built-up sections by methods that will maintain true alignment of axes without exceeding specified tolerances.
 2. The maximum allowable VOC content for field applied galvanizing repair paint shall be 250 grams/liter.
 3. Use weld sizes, fabrication sequence, and equipment for AESS that limit distortions to allowable tolerances.
 4. Provide continuous, sealed welds at angle to gusset-plate connections and similar locations where Category 1 AESS is exposed to weather.
 5. Provide continuous welds of uniform size and profile where Category 1 AESS is welded.
 6. Grind butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus 0 inch for Category 1 and Category 2 AESS.
 7. Make butt and groove welds flush to adjacent surfaces within tolerance of plus 1/16 inch, minus 0 inch for Category 1 and Category 2 AESS. Do not grind unless required for clearances or for fitting other components, or unless directed to correct unacceptable work.
 8. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 9. At locations where welding on the far side of an exposed connection of Category 1 and Category 2 AESS occurs, grind distortions and marking of the steel to a smooth profile aligned with adjacent material.
 10. Make fillet welds for Category 1 and Category 2 AESS oversize and grind to uniform profile with smooth face and transition.
 11. Make fillet welds for Category 1 and Category 2 AESS of uniform size and profile with exposed face smooth and slightly concave. Do not grind unless directed to correct unacceptable work.

2.7 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Do not quench or apply post-galvanizing treatments that might interfere with paint adhesion.
 - 2. Fill vent and drain holes that will be exposed in the finished Work, unless indicated to remain as weep holes, by plugging with zinc solder and filing off smooth.
 - 3. Galvanize steel to be embedded in cast-in-place concrete, and attached to miscellaneous structural-steel located in exterior walls, but not exposed in the finish work.
- B. Do not galvanize AESS steel that is scheduled to be painted with high performance paint system specified or protected with intumescent coating.

2.8 SURFACE PREPARATION

- A. Surface Preparation for Nongalvanized Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Blast cleaning operations shall not be conducted when the relative humidity of the air is greater than 85% or when the surface temperature of the steel is less than 5 deg. F. above the temperature at which condensation will occur, or when these conditions are anticipated. Remove all traces of blast residue and dust in a manner that will not contaminate the surfaces. Take every precaution to prevent contamination of surfaces. Workmen shall wear gloves free of grease and/or oil when handling blast cleaned steel.
- B. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.9 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded, except if universal weld through primer is applied to surfaces to be welded (use compatible primer).
 - 3. Surfaces to be high-strength bolted with slip-critical connections, except where zinc rich primer is applied.
 - 4. Surfaces to receive sprayed fire-resistive materials, or intumescent coatings.
 - 5. Galvanized surfaces.

2.10 SHOP PAINTING

- A. Architecturally exposed structural steel shall receive specified shop coats of paint except surfaces of high-strength bolted connections shall be blocked out after receiving prime coats. Remaining portions of steel members shall be finished with specified finish coats of paint.

- B. Treat milled surfaces as specified under "Materials".
- C. Apply specified primer to provide a minimum dry film thickness as recommended by the paint manufacturer but in no case less than 2.0 mils, except for milled surfaces. No painting shall be done when the surface temperature of the steel is below the temperature at which condensation will occur. Apply paint thoroughly and evenly to dry surfaces in accordance with manufacturer's directions.

2.11 SOURCE QUALITY CONTROL

- A. Testing and inspection of architecturally exposed structural steel will be performed by a testing agency retained by the Owner. Provide the testing agency with the following:
 - 1. A complete set of accepted documents required under Paragraph "Submittals".
 - 2. Cutting lists, order sheets, material bills, and shipping bills.
 - 3. Information as to time and place of all rollings and shipment of material to shops.
 - 4. Representative sample pieces as requested by the testing agency.
 - 5. Full and ample means and assistance for testing all material.
 - 6. Proper facilities, including scaffolding, temporary work platforms, etc., for inspection of the work in the mills, shop and field.
- B. Each person installing connections shall be assigned an identifying symbol or mark and all shop and field connections shall be so identified so that the inspector can refer back to the person making the connection.
- C. The Inspector will perform his duties, when possible, in such a way that fabrication and erection are not unnecessarily delayed or impeded, and as follows:
 - 1. The inspector will make all tests and inspections as required by "Structural Welding Code."
 - 2. The technique for radiographic inspection will be in accordance with Section 6, Part B of the "Structural Welding Code". A double film technique will be used. One copy of each film will be sent to the Architect, the other will be retained by the Inspector.
 - 3. Ultrasonic inspection will be performed in accordance with Section 6, Part C of the "Structural Welding Code".
 - 4. Shop welds will be inspected in the shop before the work is painted or approved for shipment.
 - 5. The inspector will make all tests and inspections of high strength bolt connections as required by AISC "Specifications for Structural Joints Using ASTM A325 or A490 Bolts".
 - 6. Where inspection reveals defects, the extent of inspection will be increased as much as necessary to assure that the full extent of the defects in a joint has been found and to assure that the same defects are not present on similar parts or under similar circumstances.
 - 7. Work that is not acceptable will be marked "Repair" or "Reject", as applicable.
 - 8. The Inspector will maintain a daily record of the work he has inspected and its disposition. One copy of each of the reports will be submitted to the Architect on a weekly basis.
 - a. Welding reports of tests will be made in form prescribed in the "Structural Welding Code".

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.
- B. Examine AECS for twists, kinks, warping, gouges, and other imperfections before erecting.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep AECS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. If possible, locate welded tabs for attaching temporary bracing and safety cabling where they will be concealed from view in the completed Work.
 - 2. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set AECS accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
 - 1. Erect Category 1 AECS to the tolerances specified in AISC 303 for steel that is designated AECS.
 - 2. Erect Category 2 and Category 3 AECS to the tolerances specified in AISC 303 for steel that is not designated AECS.
- B. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- C. Check the alignment and elevations of all column supports and location of all anchor bolts with transit and level instruments before starting erection. Notify Architect of any errors. Obtain Architect's approval of methods proposed for correcting errors prior to proceeding with corrections and erection.
- D. Drift Pins may be used only to align the several parts. They shall not be used in such manner as to distort or damage the metal.
- E. Oxygen cutting of Architecturally exposed structural steel for "fitting-up" purposes shall not be done except with the acceptance of the Architect.
- F. Sliding connection shall be of the design detailed on Drawings. Exercise particular care in erection to ensure the proper functioning of these connections as expansion (sliding) joints.

- G. Make all necessary provisions for temporary shoring and bracing with connections of sufficient strength to bear imposed loads and for completion of erection where structural members are temporarily left out for erection at a later date. Provide temporary planking and working platforms as necessary to effectively complete work.
- H. Setting Bases and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen to improve bond to surfaces. Clean bottom surface of base and bearing plates.
 - 1. Set loose and attached base plates and bearing plates for structural members on wedges or other adjusting devices.
 - 2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims, but if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
 - 3. Pack grout solidly between bearing surfaces and bases or plates to ensure that no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
 - 4. For proprietary grout materials, comply with manufacturer's instructions.
- I. Field Assembly: Set structural frames accurately to lines and elevations indicated. Align and adjust various members forming part of complete frame or structure before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact before assembly. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Pretensioned.
 - 2. Orient bolt heads in same direction for each connection and to maximum extent possible in same direction for similar connections.
- B. Weld Connections: Comply with requirements in "Weld Connections" Paragraph in "Shop Connections" Article.
 - 1. Remove backing bars or runoff tabs; back-gouge and grind steel smooth for Category 1 and Category 2 AESS.
 - 2. Remove erection bolts in Category 1 and Category 2 AESS, fill holes, and grind smooth.
 - 3. Fill weld access holes in Category 1 and Category 2 AESS and grind smooth.

3.5 FIELD PAINTING

- A. Field painting shall comply with the requirements specified in Part 2 - Products, "Shop Painting".
- B. After erection, clean exposed surfaces of field connections, unpainted areas adjacent to field connections and damaged areas in the shop coat to the same standards as required for the shop coat and paint with the same primer and finish coat used in the shop coat and as recommended by the manufacturer.
 - 1. Provide minimum mechanical cleaning and surface preparation of SSPC-SP-15 for steel that requires field repair and touch up.

- C. Apply finish top coat over surfaces of architecturally exposed structural steel in the field over shop applied primer. Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
 - 1. The maximum allowable VOC content for field applied finish top-coat shall be 250 grams/liter.
- D. Refer to Division 07, Section "Applied Fireproofing" for primer, intermediate and top coat of steel scheduled to be protected with intumescent fireproofing.

3.6 ERECTION TOLERANCES

- A. Individual pieces shall be plumbed, leveled and aligned in accordance with the requirements of the "Code of Standard Practice for Steel Buildings and Bridges" except as follows:
 - 1. Plumbness of individual columns shall be held to 1:1000.
 - 2. All measurements relating to the above shall be on the theoretical centerline of the columns.

3.7 SURVEY

- A. Make an accurate survey of actual column locations immediately upon the completion of every level of steel and immediately submit same to the Architect. Resurvey shall include level below. Should column locations vary beyond the allowable tolerances, take necessary corrective measures prior to proceeding to next level and modify details and/or procedure as required.

3.8 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect AESS as specified in Division 05 Section "Metals - Structural." The testing agency will not be responsible for enforcing requirements relating to aesthetic effect.
- B. Architect will observe AESS in place to determine acceptability relating to aesthetic effect.
- C. Special Inspections: Perform all "Special Inspections" (as defined the International Building Code) as may be required by the "Building Official" to ensure approval of the work.

3.9 REPAIRS AND PROTECTION

- A. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Grind steel smooth.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
 - 2. The maximum allowable VOC content for field applied touch-up paint shall be 250 grams/liter.
- C. Touchup Painting: Cleaning and touchup painting are specified in Division 09 painting Sections.

END OF SECTION

SECTION 055000 METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Miscellaneous and ornamental metal, except structural steel framing as specified in Section 050000 and defined as structural steel in AISC "Code of Standard Practice".
 - 2. Supports, anchorage and accessories for miscellaneous metal and ornamental metal work.
 - 3. Shop prime paint on ferrous metal.
 - 4. Shop prime for (Section 099600) high performance coating, where indicated.
 - 5. Steel handrails and guardrails.
 - 6. Galvanized metal gratings and supports.
 - 7. Steel framing, supports and mounting plates at overhead doors.
 - 8. Metal ladders.
- B. Related Sections:
 - 1. Section 050000 - Metals.
 - 2. Section 089100 - Louvers.
 - 3. Section 099000 - Painting: Finish painting.
 - 4. Section 099600 - High Performance Coatings: Coating of Architecturally Exposed metal fabrication steel (AES).

1.2 REFERENCES

- A. AWS D1.1 - Structural Welding Code.
- B. SSPC PS7.01 - Steel Structures Painting Council.
- C. Specification for Design of Cold-Formed Steel Structural Members by American Iron and Steel Institute.
- D. ANSI A14.3 Safety Code for Fixed Ladders.

1.3 STAIR SYSTEM DESCRIPTION

- A. General: Provide complete stair and landing systems including stringers, landing framing, treads, landings, connections and other components necessary for the support and installation of stairs and landings, comply with NAAMM requirements for Service Class Stairs.
- B. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding following structural loads without exceeding allowable design working stress of materials for handrails, railings, anchors, and connections:
 - 1. Top Rail of Guards: Capable of withstanding following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point and in any direction.
 - 2. Handrails Not Serving as Top Rails: Capable of withstanding following loads applied as indicated:
 - a. Concentrated load of 200 lbf applied at any point and in any direction.

1.4 SUBMITTALS

- A. Comply with Section 013300.
- B. Shop Drawings: Indicate dimensions, description of materials and finishes; include plans, elevations, sections, and details of their connections and reactions to building structure. Show anchorage and accessory items. Provide templates for anchors and bolts specified for installation under other Sections, and installation procedures, including specific requirements indicated.
 - 1. Indicate design criteria and reactions to structure.
 - 2. Construction details, sizes of metal sections, thickness of metals, profiles, attachments, dimensions and field joints, method of support from structure, and finishes.

3. Work to be built-in or provided by other Sections.
 4. Welding: Indicate welded connections, both shop and field, using standard AWS welding symbols. Indicate net weld lengths.
 5. Provide shop drawings signed and sealed by qualified professional engineer responsible for their preparation licensed in State where project is located.
- C. Calculations: Structural design shall be performed by a Professional Engineer, licensed in the state where Project is located, indicating structural integrity of members, anchors, fasteners and connections to building structure, in accordance with specified criteria. Submit signed engineering calculations concurrently with the shop drawings to Architect/Engineer upon request.
1. Engineering Responsibility: Calculations shall be reviewed for stated design assumptions, general compliance to specified requirements, and forces imposed on structure. The accuracy of the design calculations shall be the sole responsibility of the Contractor's Professional Engineer.
- D. Welding Certificates: Copies of certificates for welding procedures and personnel.

1.5 QUALITY ASSURANCE

- A. Applicable Standards: AISC "Specifications for Design of Cold-Formed Steel Structural Members" and AWS "Structural Welding Code".
- B. Qualification for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".
- C. Field Measurements: Take field measurements prior to fabrication to insure proper fitting of work.
- D. Shop Assembly: Preassemble metal items in shop to greatest extent possible, so as to minimize field splicing and assembly. Disassemble units only to extent necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- E. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project and with record of successful in-service performance, as well as sufficient production capacity to produce required units.
- F. Professional Engineer Qualifications: Professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of kind indicated. Engineering services are defined as those performed for installations of handrails and railing systems that are similar to those indicated for this Project in material, design, and extent of work.

1.6 HANDLING AND STORAGE

- A. Load, unload, handle and store work in manner that will not bend, deform or otherwise damage metal. Store so metal and shop coats will not be subject to weather or moisture, store off ground and provide covering for metal in storage.

1.7 COORDINATION

- A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Metal Surfaces: For fabrication of miscellaneous metal work items which will be exposed to view, use only materials which are smooth and free of surface blemishes, including pitting, seam marks, roller marks, rolled trade names and roughness. Select steel for exposed work to provide best possible appearance.
- B. Steel Plates, Shapes and Bars: ASTM A36.

- C. Steel Tubing: ASTM A501 or ASTM A500.
- D. Steel Pipe: ASTM A53, Type S, Grade A, standard weight and extra-strong as required, galvanized and plain.
- E. Galvanized Sheet Metal: ASTM A526 or A527, G-90 coating designation with both sides of metal prime painted.
- F. Galvanizing: ASTM A123, hot dip galvanizing, thickness Grade 55 unless otherwise indicated.
 - 1. Galvanize exterior steel fabrications, steel at exterior wall locations, and where steel is exposed to weather.
- G. Fasteners: As indicated and recommended by manufacturer. Provide zinc- coated fasteners for exterior use or where built into exterior walls.
 - 1. Provide stainless steel fasteners where indicated and where dissimilar metals are connected. Where dissimilar metals are connected, provide neoprene spacer or washer for isolation.
- H. Stainless Steel: ASTM A167, Type 304 with #4 finish. Passivate exterior stainless steel.
- I. Metal Primer Paint: Provide comparable primer recommended by finish coat manufacturer which is lead and chromate free, Low VOC complying with VOC guidelines.
 - 1. Primer for Metal to Receive High Performance Coatings (HPC): See Section 099600 for products to be applied by this Section.
 - 2. Primer to Receive Fire Protection Treatment: See applicable Division 7 Section for primer to be applied by this Section.
 - 3. Primers for Painting: See Section 099000 for primers to be applied by this Section.

2.2 FABRICATION

- A. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to radius of 1/32 inch, unless otherwise shown. Form bent metal corners to smallest radius possible without causing grain separation or otherwise impairing work.
- B. Weld corners and seams continuously and in accordance with AWS. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.
- C. Form exposed connections with hairline joints which are flush and smooth, using concealed fasteners wherever possible.
- D. Fabricate and space anchoring devices to provide adequate support. Cut, reinforce, drill and tap metal work to receive finish hardware and similar items.
- E. Shop Painting: Remove scale, rust and other deleterious materials before shop coat of paint is applied. Apply shop coat of metal primer to fabricated metal items in accordance with manufacturer's printed instructions, with full coverage of joints, corners and edges.
- F. Primer: High Performance Coating: At high performance painting use SSPC-6, complying with Section 099600.
 - 1. Apply shop primer after surface preparation in compliance with primer manufacturer's instructions at a rate to provide uniform dry film thickness of 1.5 mils, maintain minimum coverage at joints, corners, edges and exposed surfaces.

2.3 HANDRAILS AND RAILINGS

- A. (MET RAIL) Catwalk/lighting rail system.
- B. Cope intersections of rails and posts, weld joints and grind smooth. Butt weld end-to-end joints of railing or use welding connectors.
 - 1. Galvanize exterior handrails and railings.
- C. Weld corners and seams continuously and in accordance with recommendations of AWS. Grind exposed welds smooth and flush, to match and blend with adjoining surface. Discoloration of finished surfaces is not acceptable.

- D. Form exposed connections with flush, smooth, hairline joints, using concealed fasteners. Provide for anchorage to supporting structure. Fabricate and space anchoring devices as indicated and required for adequate support.
- E. Provide brackets, flanges, and anchors for railing posts and for handrail supports. Provide inserts and sleeves for anchorage to concrete or masonry work.
- F. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of pipe.
- G. Provide wall returns at ends of wall-mounted handrails, except where otherwise indicated.
- H. Close exposed ends of pipe by welding 3/16 inch thick steel plate in place or by use of prefabricated fittings.

2.4 FABRICATION OF HANDRAILS AND GUARDRAILS

- A. General:
 - 1. Verify dimensions on site prior to shop fabrication.
 - 2. Accurately form and fit components and connections. Grind exposed edges and welds smooth and flush.
 - 3. Thoroughly clean surfaces of rust, scale, grease, and foreign matter prior to galvanizing or prime painting. Allow to dry thoroughly before applying priming material.
- B. Fabrication of Handrails and Guardrails:
 - 1. Handrails: Handrails shall have an outside diameter of 1-1/2".
 - 2. Inside handrails shall be continuous and shall sweep around smoothly at landings.
 - 3. Outside handrails shall be mounted on wall brackets as required to meet performance requirements and shall have extensions at top and bottom of stair runs as indicated on the Drawings and required by accessibility standards.
 - 4. Intermediate Guard Configuration: Intermediate guard shall be configured as indicated on drawings.
 - a. Provide railing system consisting of 1-1/2 inch round sloping strands following each stair run and 1-1/2 inch round top rails that continuously sweep around at each corner.
 - 5. At top floor of stair system and at each floor landing (except lower level) provide 3'-6" high guard rails.
 - 6. Continue handrail and intermediate guard system down to the lower level where concrete stairs are indicated.

2.5 METAL GRATINGS

- A. (GRT) Galvanized Metal Gratings: Borden Metal Products Type B size 5 pressure locked steel gratings with 1-1/4 inch by 1/8 inch bearing bars at 1-3/16 inch centers and 3/4 inch by 1/8 inch cross bars at 4 inch centers, galvanized finish in accordance with ASTM A123.

2.6 METAL LADDERS

- A. (MET FAB) Interior Steel Ladder:
 - 1. Comply with ANSI A14.3, unless otherwise indicated.
 - 2. Height as indicated on Drawings.
 - 3. Siderails: Continuous, 3/8 by 2-1/2 inch steel flat bars, with eased edges. Space siderails 16 inches apart, unless otherwise indicated.
 - 4. Rungs: 3/4 inch diameter steel bars at 12 inches on center.
 - 5. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
 - 6. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
 - 7. Support each ladder at top and bottom, and not more than 60 inches o.c. with welded or bolted steel brackets.
 - 8. Prime with zinc-rich primer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which miscellaneous metal items are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Provide setting drawings, diagrams, templates, instructions and directions for installation of anchorages, such as concrete inserts, anchor bolts, and miscellaneous items having integral anchors, which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.
- B. Provide anchorage devices and fasteners where necessary for securing miscellaneous metal items to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
- C. Perform cutting, drilling and fitting required for installation of miscellaneous metal items. Set work accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in formwork for items which are to be built into concrete, masonry or similar construction.
- D. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind joints smooth and touch up shop paint coat. Do not weld, cut or abrade surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.
- E. Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.
- F. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide minimum dry film thickness of 2 mils.
- G. Install metal gratings and supports according to reviewed shop drawings and manufacturer instructions.

3.3 HANDRAILS AND RAILINGS

- A. Provide anchorage devices and fasteners for securing handrails and railings to in-place construction.
- B. Adjust railing prior to securing in-place to ensure proper matching at butting joints and correct alignment. Secure posts and rail ends to building construction.
- C. Anchor steel pipe rails in concrete by means of galvanized pipe sleeves set and anchored into concrete. Provide steel plate closure secured to bottom of sleeve and of width and length not less than one inch greater than sleeve. After post is inserted into sleeve, fill sleeve solid with quick-setting hydraulic cement.
- D. Anchor rail ends to supporting structure with flanges welded to rail ends and bolted to supporting members in accordance with reviewed shop drawings. Secure handrails to walls with wall brackets and end fittings

END OF SECTION

SECTION 057005 LANDSCAPE METALWORK

PART 1 GENERAL

1.1 DESCRIPTION

- A. Provide all labor, materials and equipment as required for complete, finished installation of metalwork as shown on the drawings and specified including the following items:
 - 1. Railings and Guardrails
 - 2. Miscellaneous landscape metal
- B. Metal fabrication includes plates, bars, strips, tubes, pipes and castings made from iron and steel that are not specifically listed herein.

1.2 REFERENCES AND STANDARDS

- A. "Code for Arc and Gas Welding in Building Construction" of American Welding Society, AWS D1.1, latest edition, with current supplements and addenda, is hereby made a part of this Section and miscellaneous metalwork shall conform to the applicable requirements therein, except as otherwise specified herein or shown on the drawings. Nothing contained herein shall be construed as permitting work that is contrary to code requirements or governing rules and regulations.
- B. All work shall conform to the American Institute of Steel Construction Specifications for design, erection and fabrication, and acceptable standards of good practice. Finished members shall be true to line and free from twists and bends.
- C. SSPC "Steel Structures Painting Manual, Volume 2, Systems and Specifications".
- D. National Association of Architectural Metal Manufacturers (NAAMM): Metal Finishes Manual

1.3 SUBMITTALS, PER SECTION 013300

- A. Product Data: Furnish manufacturer's literature including paint, grout and recommendations for cleaning.
- B. Shop Drawings: Shall show dimensions, sizes, thicknesses, gauges, finishes, joining attachments and relationship of work to adjoining construction. Where items must fit and coordinate with finished surfaces and/or constructed spaces, take measurements at site and not from drawings. Where concrete, masonry or other materials must be set to exact locations to receive work, furnish assistance and directions necessary to permit other trades to properly locate their work. Where welded connectors, concrete or masonry inserts are required to receive work, shop drawings shall show exact locations required, and all such drawings shall be furnished to the trades responsible for installing the connectors or inserts. Catalogue work sheets showing illustrated cuts of item to be furnished, scale details and dimensions may be submitted for standard manufactured items.
- C. Provide templates for anchorage installations by others.
- D. Samples: Furnish finish samples of uncoated steel anchor and bolts for farm machinery, etc.
- E. Certificates: Submit certification signed by California registered civil or structural engineer indicating compliance with Contract Documents and code requirements where required.

1.4 SYSTEM DESCRIPTION

- A. Design Requirements: Drawings indicate metal sizes and shapes; unless otherwise specifically indicated, design components and fabrications of gages and thicknesses to withstand anticipated loads as required by California Building Code.
 - 1. Railings: Support a lateral force of 50 lbs./lin. Ft. uniform load and 200 lbs. at any single point without permanent set or damage; ASTM E 935.

- a. Top Rails: Design to support minimum 200 lb. concentrated single point load applied at any point vertically or horizontally.
- B. Rail Regulatory Requirements:
 - 1. Access: Comply with California Building Code and Americans with Disabilities Act Accessibility Guidelines (ADAAG) Access Requirements and finishes as designated by NAAMM "Metal Finishes Manual" and "Pipe Railing Manual" and referenced standards. Rails shall be welded construction; cap exposed ends.
 - 2. Building Code: Comply with requirements of applicable building codes for railing design, except where more restrictive codes are specified.

1.5 QUALITY ASSURANCE

- A. Fabricator Qualifications: Firm with minimum five years successful experience fabricating metal items similar to those required for Project.

PART 2 MATERIALS

2.1 BASIC MATERIALS AND ACCESSORIES

- A. Steel Tubing: ASTM A500 (cold-formed), Minimum Grade B, seamless where exposed.
- B. Steel Pipe: ASTM A53, Type S, seamless, Grade A, minimum standard weight, STD or Schedule 40, unless otherwise noted.
- C. Miscellaneous steel plates and structural steel shapes conforming to ASTM A36-(latest edition).
- D. Bolts: Structural grade steel, ASTM A307-(latest edition), with suitable hex nuts and washers, all galvanized except where noted otherwise.
- E. Structural Steel Sheet: Hot rolled, ASTM A1011; or cold rolled, ASTM A 1008, Class 1 of grade required for design loading.
- F. Castings: Gray iron, ASTM A 48, Class 30; malleable iron, ASTM A47.
- G. Concrete Inserts: Threaded or wedge type; galvanized ferrous castings, either malleable iron ASTM A47 or cast steel ASTM A27. Provide bolts, washers and shims as required, hot-dip galvanized, ASTM A153.
- H. Fasteners and Rough Hardware: Type as required for specific usage; provide zinc-coated fasteners for exterior use or where built into exterior walls.
- I. Welding Materials: AWS D1.1, type required for materials being welded.
- J. Stainless Steel
 - 1. Plate, Sheet and Strip: ASTM A167, Type 302 or Type 304. Provide mill finish unless otherwise shown.
 - 2. Bars and Shapes: ASTM A276, Type 304. Provide mill finish unless otherwise shown.
 - 3. Tubing: ASTM A269
 - 4. Stainless Steel Railing Finishes: Submit finish sample for approval. Remove tool and die marks and stretch lines or blend into finish. Grind and polish surfaces to produce uniform, directionally textured, polished finish indicated free of cross scratches. Run grain with long dimension of each piece.
 - 5. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
- K. Aluminum: Provide alloy and temper recommended by aluminum producer or finisher for type and use and finish indicated; sized for strength and durability consistent with application involved. Comply with the following finishes as designated by NAAMM "Metal Finishes Manual" and referenced standards:

1. High performance Organic Coating: AA-C12C42R1x, prepared, pretreated and coated with minimum two coat system; AAMA 2605.
 2. Comply with following minimum standards for aluminum.
 - a. Extruded Bar and Shapes: ASTM B221, 6063-T6.
 - b. Extruded Pipe and Tube: ASTM B429, 6063-T6.
 - c. Drawn Seamless Tube: ASTM B483, 6063-T832.
 - d. Plate and Sheet: ASTM B209, 6061-T6.
 - e. Die and Hand Forgings: ASTM B247, 6061-T6.
 - f. Castings: ASTM B26, 356.0-T6.
- L. Weathering Steel: (COR-TEN), ASTM A242.
- M. Castings: Gray iron, ASTM A 48, Class 30; malleable iron, ASTM A 47.
- N. Screws: Galvanized zinc, electro-plated or brass.
- O. Welding Electrodes: As permitted by AWS A5.
- P. Galvanizing:
 1. Galvanize fabricated items as shown and specified after fabrication in accordance with ASTM A123-09.
 2. Parts shall be made in suitable sections. First clean in a hot pickling bath to remove scale and then rinse clean with clear water. After pickling and washing, dip parts in liquid zinc tank sufficient length of time to heat parts to zinc temperature, then remove and allow to drip and cool; straighten as required.
- Q. Non-Metallic Shrinkage Resistant Grout: Premixed, nonmetallic, non-corrosive, non-staining, shrinkage resistant product containing selected silica sands, Portland cement, shrinkage compensating agents, plasticizing and water-reducing agents, complying with CE-CRD-C621 and ASTM C1107, free of gas-producing or gas-releasing agents, oxidizing catalysts, inorganic accelerators and chlorides.
- R. Fasteners and Anchorage Devices: Provide fasteners complying with the requirements of Industrial Fasteners Institute standards. Type, grade, class and style best suited for the respective purpose. Use countersunk flat-head Phillips type machine screws for exposed fasteners, except where Allen head screws are required. Use galvanized steel or stainless steel fasteners for exterior construction and for fastening components fabricated of galvanized steel except where specified otherwise. Fasteners exposed in finish surfaces to match finish of adjacent surfaces.
- S. Component Connections: Fabricate component connections to support specified design loads.
- T. Material Selection: Select materials for straightness, free of defects and irregularities.
 1. Exposed-to-view surfaces exhibiting pitting, seam marks, roller marks, "oil canning", stains, discolorations, and imperfections on finished units are not acceptable.
- U. Joints: Make exposed joints flush butt type, hairline joints where mechanically fastened; provide concealed connection devices with hidden fasteners.
 1. Fabricate continuous items with joints neatly fitted and secured.
 2. Ease exposed edges to approximate 1/32" uniform radius.
 3. Fabricate joints exposed to weather in manner to exclude water or provide weep holes where water could accumulate.
- V. Welding: Comply with AWS for recommended practices in welding each type of material; provide welds behind finished surfaces without distortion or discoloration on exposed side; dress exposed and contact surfaces.
- W. Exposed Mechanical Fastenings: Flush countersunk fasteners unobtrusively located, consistent with design of structure.
- X. Assemblage: fit and shop assemble in largest practical sections for site delivery.
- Y. Dissimilar Materials: Separate dissimilar materials with bituminous paint where concealed, with preformed separators, or similar method to prevent corrosion.

2.2 SPECIALLY FABRICATED PRODUCTS

- A. Signage equipment / elements anchors and bolts: Weathering steel(COR-TEN) allowed to rust after installation as shown and specified.
- B. Railings and Handrails: Make all bar railings of milled steel unless noted otherwise; all connections welded. Where pipe railing are required, make from (1-1/2) outside diameter seamless steel pipe unless noted otherwise. Fabricate in largest sections feasible; all shop joints welded; all field joints with concealed sleeves and pins.
- C. Railings and Handrails Design: Continuous railings conforming to applicable code and design requirements. Construct to support a concentrated load of 250 lbs. Applied at any point and in any direction and for a uniform load of 50 lbs. Per foot applied in any direction. The concentrated and uniform loading conditions shall not be applied simultaneously.
 - 1. Wall Rail Brackets: Castings as accepted by Owner's Representative.
 - 2. Wall returns: 90 degree elbow return with 1/4" maximum clearance unless otherwise indicated.
 - 3. Provide wall plates only where indicated and where required by applicable codes.

2.3 SHOP PAINTING

- A. General:
 - 1. Shop paint miscellaneous metal work, except members or portions of members to be embedded in concrete or masonry, surfaces and edges to be field welded unless otherwise specified.
 - 2. Remove oil, grease and similar contaminants in accordance with SSPC SP-1 "Solvent Cleaning", prior to any additional surface preparation specified.
 - 3.
 - 4. Clean and prepare metal surfaces before applying shop coat. Remove rust and mill scale in accordance with SSPC SP-3 "Power Tool Cleaning".
 - 5. Immediately after surface preparation, apply primer in accordance with manufacturer's instructions. Use painting methods which will result in full coverage and dry film thickness specified.
 - 6. Apply one shop coat of primer to fabricated metal items, except apply 2 coats of primer to surfaces inaccessible after assembly or erection. In addition, apply one shop coat of finish paint to entire surfaces of exterior loose lintels, shelf and relieving angles, dunnage and other items as noted or specified. Change color of second or finish coat to distinguish it from the first coat.
 - 7. Separate dissimilar metals with one coat of dielectric separator. Do not extend coating onto exposed or finished surfaces.
 - 8. Application: Do not paint when ambient temperature is below 40°F. Paint in dry weather or under cover; paint over dry rust-free surfaces. Stir paint and keep at uniform consistency during application. Apply paint by brush or spray per manufacturer's directions to a dry film thickness of not less than 1.5 mils (approximately 370-375 SF of surface per gallon); do not thin paint in excess of manufacturer's recommendations. Allow paint to dry before handling or shipment.
- B. Fully Concealed Items:
 - 1. Clean steel work by "Solvent Cleaning" method specified in SSPC-SP 1, followed by "Hand Tool Cleaning" to remove loose mill scale and rust by methods specified in SSPC-SP 2.
 - 2. Apply ferrous metal primer immediately after cleaning to uniform dry film thickness of 2.0 mils.
 - 3. Apply second coat of same primer and same thickness on concealed work which will be built into below grade work, or will be concealed in areas designated high humidity areas.
- C. Exposed Exterior Items:
 - 1. Apply the following cleaning, treatment and painting to exterior work which will be fully exposed or only partially exposed, and to exposed interior work in areas designated as high humidity areas.

2. Clean by "Solvent Cleaning" method specified in SSPC-SP 1, followed by "Power Tool Cleaning" to remove loose mill scale and rust by methods specified in SSPC-SP 3, followed by "Pickling" to remove remaining mill scale and rust by methods specified in SSPC-SP 8. Power tool cleaning and pickling may be omitted from work fabricated from cold-rolled or cold-finished stock, and from castings, provided surfaces are not heavily rusted.
3. Apply pretreatment as recommended by ferrous metal primer manufacturer.
4. Apply prime coat of ferrous metal primer immediately after pretreatment to uniform dry film thickness of 2.0 mils.

2.4 FINISHES: EXCEPT AS OTHERWISE NOTED ON THE DRAWINGS OR SPECIFIED:

- A. Preparation of Metal:
 1. Ferrous Metal: SSPC-SP-6 (Commercial Blast Clean)
 2. Galvanized Metal: SSPC-SP-1 (Solvent Clean)
 3. Cut or Welded Galvanized Metal: Surface clean cuts and welds to bright metal
 4. Aluminum: SSPC-SP-1 (Solvent Clean)
- B. Primer:
 1. Ferrous Metal: Tnemec 90-97 (Tneme-Zinc)
 2. Galvanized Metal: Tnemec Series P66 Epoxoline
 3. Cut or Welded Galvanized Metal: Paint with organic ZMC rich primer with a metallic zinc content of not less than 78% by weight in dry applied film Tnemec-zinc 90E-92 or approved equal. Apply in dry film thickness between 2.0 - 3.5 mils.
 4. Aluminum: Tnemec Series 66 Epoxoline
- C. Finish Coats:
 1. Interior: Tnemec Series (73) or (74) Endura-Shield
 2. Exterior: Tnemec Series 74 Endura-Shield
 3. Heavy duty Industrial Use: Tnemec Series 74 Endura-Shield

PART 3 EXECUTION

3.1 CONDITION OF SURFACES:

- A. Inspect all surfaces to receive site metal work and report all defects which would interfere with this installation. Starting work implies acceptance of surfaces as satisfactory.

3.2 FIELD MEASUREMENTS:

- A. Take field measurements prior to preparation of shop drawings and fabrication, where possible; do not delay job progress; allow for trimming and fitting where necessary.

3.3 WORKMANSHIP

- A. Verify all measurements at job. Coordinate all metalwork with adjoining work for details of attachments, fittings, etc. Do all cutting, shearing, drilling, punching, threading, tapping, etc., required for site metalwork or for attachment of adjacent work. Drill or punch holes; do not use cutting torch. Shearing and punching shall leave true lines and surfaces. Obtain Owner's Representative's review prior to site cutting or making adjustments which are not part of scheduled work. Perform necessary cutting and altering for installation and coordination with other work.
- B. Conceal all fastenings where feasible. Thickness of metal and details of assembly and supports shall give ample strength and stiffness. Form joints exposed to weather to exclude water.
- C. Make all permanent connections in ferrous metal surfaces using welds where at all possible; do not use bolts or screws where they can be avoided.
- D. Provide all lugs, clips, anchors, miscellaneous fastenings necessary for complete assembly and installation.

- E. Set all work plumb, true, rigid, neatly trimmed out, accurately fitted and free from distortions or defects detrimental to appearance or performance. Miter corners and angles of exposed moldings and frames unless otherwise noted.
- F. Set railings where shown set in sleeves or cored with quick-setting non-shrink anchor cement. Size sleeves for approximately 1/4" clearance all around.
- G. Where items must be incorporated or built into adjacent work, deliver to trade responsible for such work in sufficient time that progress of work is not delayed. Be responsible for proper location of such items.
- H. Make provisions for erection stresses by temporary bracing; Keep work in alignment.
- I. Install ornamental metal items in accordance with manufacturer's recommendations, installation instructions, and approved shop drawings.
- J. Install items plumb, true and in correct relation to adjacent work, free from distortion or defects detrimental to appearance and performance.
- K. Prior to securing continuous items, adjust to ensure proper matching at butt joints and correct alignment throughout their length.
- L. Tolerances: Accurately align and locate components to required lines and levels to conform to following tolerances:
 - 1. Plumb: 1/8" in 10'-0"; 1/4" in 40'-0"; non-cumulative.
 - 2. Level: 1/8" in 20'-0"; 1/4" in 40'-0"; non-cumulative.
 - 3. Location: 3/8" maximum deviation from measured theoretical location (any member and location).

3.4 WELDING:

- A. Perform all welding in accordance with AWS Code D1.1. Welds shall be made only by operators experienced in performing the type of work indicated. Welds normally exposed to view in the finished work shall be uniformly made and shall be ground smooth. Where welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter, or tramp metal.
- B. Field Welding: Comply with AWS Welding Code for procedures related to field welding as related to appearance and quality of welds made and for methods used in correcting welding work. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals. Obtain fusion without undercut or overlap. Remove welding flux immediately. At exposed connections, finish exposed welds and surfaces smooth and blended so that no roughness shows after finishing and contour of welded surface matches those adjacent.

3.5 BOLTED, SCREWED AND RIVETED CONNECTIONS

- A. In general, use bolts for field connections only and then only as detailed. Provide washers under all heads and nuts bearing on wood. Draw all nuts tight and nick threads of permanent connections to prevent loosening. Use beveled washers where bearing is on sloped surfaces.
- B. Where screws must be used for permanent connections in ferrous metal, use flat-head-type, countersunk, with screw slots filled and finished smooth and flush.
- C. Where rivets are used, they shall be machine-driven, tight, heads centered, countersunk, and finished flush and smooth.

3.6 SURFACE TREATMENT AND PROTECTIVE COATINGS

- A. Cleaning: Thoroughly clean all mill scale, rust, dirt, grease and other foreign matter from ferrous metal prior to any galvanizing, hot phosphate treatment or painting. Conditions which are too severe to be removed by hand cleaning methods shall be cleaned per SSPC "Surface Preparation Specifications," "Solvent Cleaning, SSPC-SP-1"; "Power Tool Cleaning, SSPC-SP-3"; or "Brush-Off Blast Cleaning, SSPC-SP 7"; as required.

- B. Exterior Ferrous Metal: Welds, burrs, and rough surfaces ground smooth and completed assembly cleaned, hot phosphate treated. Hot phosphate treatment not required on items which are not exposed in the finish work or on those items where size prohibits such treatment. Indicate on shop drawings where treatment is proposed to be omitted.

3.7 PAINTING

- A. Prime Coat: After material has been properly cleaned and treated, apply two shop prime coats, each of a different color, to all surfaces except those encased in concrete or masonry. Apply all paint per manufacturer's directions. Spot paint all abrasions and field connections after assembly. Shop coats shall be dry prior to shipment to job site.
- B. Finish Coats: Apply one coat per manufacturer's instructions. May be shop-applied where applicable.

3.8 GALVANIZING

- A. Galvanize fabricated items after fabrication in accordance with ASTM A123-66.
- B. Parts shall be made in suitable sections. First clean in a hot pickling bath to remove all scale and then rinse clean with clear water. After pickling and washing, dip parts in liquid zinc tank sufficient length of time to heat parts to zinc temperature, then remove and allow to drip and cool; straighten as required.

3.9 INSTALLATION

- A. Coordinate and furnish anchorages, setting drawings, diagrams, templates, instructions and directions for installation of anchorages, including concrete inserts, sleeves, anchor bolts and other miscellaneous items having integral anchors that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to the project site. Deliver items which are to be built into the work of other Sections in time so as not to delay the progress of the Work.
- B. Protect finished surfaces against damage during construction and remove protection at time of substantial completion.
- C. Railings and Guardrails:
 - 1. Anchor posts of railings into concrete by means of pipe sleeves preset and anchored into concrete. Set sleeves in concrete with tops flush with finish surface elevations and protect sleeves from water and concrete entry. After posts have been inserted into sleeves, solidly fill annular space between post and sleeve with non-shrink non-metallic grout. Cover anchorage joint with a round steel flange welded to post after placement of anchoring material.
 - 2. Anchor posts to steel members with steel oval flanges, angle type or floor type as required by conditions, welded to posts and bolted to steel supporting members.
 - 3. Mount handrails only on completed walls. Do not support handrails temporarily by any means not satisfying structural performance requirements. Mount handrails only on gypsum board assemblies reinforced to receive anchors. Adjust railings prior to anchoring to ensure matching alignment at abutting joints. Locate posts at spacing indicated, or if not indicated, at equal intervals as required by design loadings.
 - 4. Secure handrails to wall with wall brackets and end fittings. Provide brackets of design shown, with flanges tapped for concealed anchorage and with not less than 1-1/2 in. clearance from inside face of handrail and finished wall surface. Located brackets as indicated, or if not indicated, at equal spacings as required by design loads.
- D. Loose Plates: Prior to setting loose bearing and setting plates, clean concrete and masonry bearing surfaces of any bond reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates. Set on wedges or other adjustable devices. After members have been positioned and plumbed, tighten anchor bolts. do not remove wedges or shims, but if protruding, cut off flush with the edge of the plate before packing with grout. Pack grout solidly between bearing surfaces and plates to ensure no voids remain.

- E. Immediately after erection, clean field welds, bolted connections, marred and abraded surfaces. Paint and touch-up paint with the specified paint system. Touch up galvanized surfaces in accordance with ASTM A780.
- F. Replace items damaged in course of construction.

3.10 PROTECTION AND CLEANING, PER SECTION 017700.

- A. Remove all soil and foreign matter from finished surface and apply such protective measures as may be required to prevent damage or discoloration of any kind until acceptance of project.

END OF SECTION

SECTION 057300 DECORATIVE METAL RAILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Decorative metal railings (ORN RAIL).
- B. Related Sections:
 - 1. Section 055000 - Metal Fabrications.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
 - 1. Steel: 72 percent of minimum yield strength.
- C. Structural Performance of Handrails and Railings: Provide handrails and railings capable of withstanding following structural loads without exceeding allowable design working stress of materials for handrails, railings, anchors, and connections:
 - 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. (0.73 kN/m) applied in any direction.
 - b. Concentrated load of 200 lbf (0.89 kN) applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 - 2. Infill of Guards:
 - a. Concentrated load of 50 lbf (0.22 kN) applied horizontally on an area of 1 sq. ft. (0.093 sq. m).
 - b. Infill load and other loads need not be assumed to act concurrently.

1.3 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300.
 - 1. Indicate fabrication and installation of decorative metal railings, including plans, elevations and details of components and attachments to other units of work. Indicate materials, profiles of each decorative metal railings member and fitting, joinery, finishes, fasteners, anchorages and accessory items.
 - 2. Include setting drawings, templates and directions for location and installation of items and anchor bolts and other anchorage devices to be installed as unit of work of other sections.
- B. Product Data: Submit product data for each product used in decorative metal railings, including finishing materials and methods.
- C. Samples: Submit samples of metal in accordance with Section 013300, for color selection and appearance acceptance. Prepare samples of metal of same alloy and gauge to be used for work.
 - 1. Submit three 8 inch by 8 inch samples of finish and color as selected.
- D. Installer's Certificate: Signed by manufacture certifying the welders comply with requirements specified under Quality Assurance article.

1.4 QUALITY ASSURANCE

- A. Fabricators Qualifications: Firm experienced in successfully producing decorative metal railings similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in Work.
- B. Installer Qualifications: Arrange for installation of decorative metal railings specified in this section by same firm that fabricated unit.

- C. Manufacturer shall have minimum of 5 years experience in supplying and installing of major jobs in ornamental metal work. Prospective manufacturer shall supply list (prior to bid acceptance time) of jobs Architect or Owner may inspect, in order to ascertain this manufacturer's ability to both manufacture and perform in full compliance with this specification.
 - 1. Architect or Owner shall also have right to request full size mock up of unit prior to placing contract with manufacturer at no cost or obligation in order to determine manufacturer's ability to do quality work. Architect or Owner reserves right to reject without any liability or obligation to Architect or Owner, any manufacturer which, in their opinion, cannot or will not meet these specifications.
- D. Verify dimensions by field measurement before fabrication. Design units to provide for adjustment and fitting of components during field installation. Preassemble units at shop to minimize mechanical joints, splicing and field assembly of units.
- E. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS Standard Qualification Procedure.
- F. Qualify welding processes and welding operators in accordance with the following:
 - 1. AWS D1.1 Structural Welding Code - Steel.
 - 2. Certify that each welder employed in unit of Work of this section has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible, to insure proper fitting of decorative metal railings. Do not delay job progress; allow for adjustments and fitting where taking of field measurements before fabrication might delay work.

1.6 DELIVERY, HANDLING AND STORAGE

- A. Store components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin or polyethylene sheeting in manner that permits air circulation within covering.
- B. Load, unload, and handle decorative metal railings in a manner that will not bend, deform or otherwise damage metal or finishes.

PART 2 PRODUCTS

2.1 STEEL AND IRON

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Tubing: ASTM A 500 (cold formed).
- C. Bars: Hot-rolled, carbon steel complying with ASTM A 29/A 29M, Grade 1010.
- D. Plates, Shapes, and Bars: ASTM A 36/A 36M.
- E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.2 FASTENERS

- A. Fastener Materials: Unless otherwise indicated, provide the following:
 - 1. Uncoated Steel Components: Plated-steel fasteners complying with ASTM B 633, Class Fe/Zn 25 for electrodeposited zinc coating where concealed; Type 304 stainless-steel fasteners where exposed.
 - 2. Dissimilar Metals: Type 304 stainless-steel fasteners.

- B. Fasteners for Anchoring to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.
- C. Provide concealed fasteners for interconnecting railing components and for attaching railings to other work unless otherwise indicated.
- D. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
- E. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.
 - 1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.3 ACCESSORIES

- A. Welding Electrodes and Filler Metal: Type and alloy of filler metal and electrodes as recommended by producer of metal to be welded, complying with applicable AWS specifications, and as required for color match, strength and compatibility in fabricated items.
- B. Nonshrink Nonmetallic Grout: Pre-mixed, factory packaged, nonstaining, noncorrosive, nongaseous grout complying with CE CRD C621. Provide grout specifically recommended by manufacturer for interior and exterior applications of type specified in this section.
- C. Interior Steel, Shop Primer: Rust-inhibitive, water-based primer, emulsion type, anti-corrosive primer for interior or exterior ferrous metals exposed to mildly corrosive environments. Coating shall be resistant to flash rusting when applied to cleaned steel.

2.4 FABRICATION

- A. Fabricate units from materials, gauges and finishes shown or specified.
- B. Form decorative metal railings to required shapes and sizes, with true curves, and angles. Provide components in sizes and profiles indicated, but not less than required to comply with requirements indicated for structural performance.
- C. Provide necessary rebates, lugs and brackets for assembly of units. Use concealed fasteners wherever possible.
- D. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 1 welds: no evidence of a welded joint.
- E. Consider clearances with adjacent materials and provide correct procedures for erection. Provide supports, anchoring devices, anchor bolts, screws, clips, seals and gaskets, and other accessories.
- F. Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.

2.5 SHOP FINISHING GENERAL

- A. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise shown and specified.
- B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:
 - 1. Interior Railings: SSPC-SP 3, "Power Tool Cleaning."

- C. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.

PART 3 EXECUTION

3.1 INSPECTION

- A. Examine areas and conditions under which ornamental metal items are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions and directions for installation of items having integral anchors which are to be embedded in concrete or masonry construction. Coordinate delivery of such items to project site.

3.3 INSTALLATION

- A. Provide anchorage device and fasteners where necessary for securing decorative metal railings items to in-place construction; including threaded fasteners for concrete and masonry inserts, toggle bolts, through-bolts, lag bolts, wood screws and other connectors as required.
- B. Perform cutting, drilling and fitting required for installation of decorative metal railings. Set products accurately in location, alignment and elevation, plumb, level, true and free of rack, measured from established lines and levels. Provide temporary bracing or anchors in form work for items which are to be built into concrete, masonry or similar construction.
- C. Fit exposed connections accurately together to form tight hairline joints, or where indicated, with uniform reveals and spaces for sealants and joint fillers. Where cutting, welding and grinding are required for proper shop fitting and jointing for ornamental metal items, restore finishes to eliminate any evidence of such corrective work.
- D. Anchor securely in manner shown, using concealed anchorages wherever possible.
- E. Do not cut or abrade finishes which cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing or provide new units as required.
- F. Restore protective coverings that have been damaged during shipment or installation of work. Remove protective coverings only when there is no possibility of damage from other work yet to be performed at same location.
 - 1. Retain protective coverings intact and remove simultaneously from similarly finished items to preclude non-uniform oxidation and discoloration.
- G. Field Welding: Comply with applicable AWS specification for procedures of manual shielded metal-arc welding, for appearance and quality of welds made, and for methods used in correcting welding work. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed welds smooth and flush and restore finish to match finish of adjacent rail surfaces.

3.4 INSTALLATION OF HANDRAILS AND RAILINGS

- A. Fit exposed connections together to form tight, hairline joints.
- B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.
 - 1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 - 2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- C. Adjust handrails and railing systems prior to anchoring to ensure matching alignment at abutting joints. Space posts at interval indicated but not less than that required by design loadings.
- D. Concrete Anchored Posts in Sleeves: Insert posts in preset sleeves cast into concrete and fill annular space between posts and sleeve solid with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.
- E. Concrete-Anchored Posts in Core-Drilled Holes: Core drill concrete to produce holes with diameter at least 3/4 inch larger than outside dimensions of post and not less than 5 inch deep. Clean holes of loose material, insert posts and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with grout manufacturer's directions.
 1. Cover anchorage joint with flange or escutcheon plate attached to post after filling of annular space.
- F. Anchor posts to metal surfaces with fittings designed for this purpose.
- G. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Use wood blocks and padding to prevent damage to railing members and fittings. Seal recessed holes of exposed locking screws using plastic filler cement, colored to match finish of handrails and railing systems.
- H. Welded Connections: Use fully welded joints for permanently connecting railing components by welding. Cope or butt components to provide 100 percent contact or use fittings designed for this purpose.
- I. Anchor rail ends to supporting structure with fittings designed for this purpose.
- J. Anchor railing ends to metal surfaces by welding.
- K. Expansion Joints: Provide expansion joints at locations indicated or, if not indicated, at intervals not to exceed 40 ft. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side; fasten internal sleeve securely to one side, locate joint within 6 inches of post.

3.5 ADJUSTING AND CLEANING

- A. Clean by washing thoroughly with clean water and soap and rinsing with clean water.
- B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

3.6 PROTECTION

- A. Protect finishes of decorative metal railings from damage during construction period by use of temporary protective coverings approved by decorative metal railings fabricator. Remove protective covering at time of Substantial Completion.
- B. Restore finishes damaged during installation and construction period so that no evidence remains of correction work. Return items which cannot be refinished in the field to the shop; make required alterations and refinish entire unit, or provide new units as required.

END OF SECTION

SECTION 061000 ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural wall, floor and roof framing
 - 2. Wall floor, and roof sheathing
 - 3. Concealed wood blocking and nailers.
 - 4. Wood furring and grounds.
 - 5. Preservative treatment.
 - 6. Fire-retardant treatment.
 - 7. Anchors nails, bolts, and screws.
- B. Related Sections:
 - 1. Section 064000 - Architectural Woodwork.
 - 2. Section 075400 – Thermoplastic Membrane Roofing.
 - 3. Section 079000 – Joint Protection.

1.2 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM):
 - 1. D2559: Standard Specification for Adhesives for Bonded Structural Wood Products for Use Under Exterior Exposure Conditions.
 - 2. D4689: Standard Specification for Adhesive, Casein Type.
 - 3. E84: Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 4. E96: Standard Test Methods for Water Vapor Transmission of Materials.
- B. American Wood Protection Association (AWPA):
 - 1. U1: Use Category System: User Specification for Treated Wood.
- C. California Building Standards Commission (CBSC):
- D. CCR Title 24 Part 2, California Building Code, 2013.
- E. Composite Panel Association (CPA) / American National Standards Institute (ANSI):
 - 1. A135.4: American National Standard, Basic Hardboard.
 - 2. A208.1: American National Standard, Particleboard.
- F. Engineered Wood Association (APA) E30: Engineered Wood Construction Guide.
- G. U. S. Department of Commerce: Voluntary Product Standard PS 20, American Softwood Lumber Standard.
- H. Underwriter's Laboratory (UL) 723: Test for Surface Burning Characteristics of Building Materials.
- I. West Coast Lumber Inspection Bureau (WCLIB) Standard 17: Grading Rules for West Coast Lumber, including Errata and Supplements.
- J. Woodwork Institute (WI): Architectural Woodwork Standards
- K. National Forest Products Association (NFPA) - National Design Specification for Wood Construction ANSI/AWC NDS-2012.

1.3 DEFINITIONS

- A. The following definitions apply to this section as they pertain to rough carpentry items.
 - 1. Rough Carpentry: Carpentry work not specified in other Sections and not used as exposed work.

1.4 DESCRIPTION

- A. Concealed wood blocking, sheathing, subflooring, underlayment, anchors, fasteners, adhesives, and related items, including accessories furnished and installed as specified herein.

1.5 SUBMITTALS

- A. Product Data: Submit for carpentry in accordance with Section 013300, Submittals.
 - 1. Submit for sheathing, tapes, sealants, and miscellaneous products specified.
- B. Certification:
 - 1. Submit letter certifying that lumber is kiln-dried to 15 - 19 percent moisture content, well seasoned, grade marked, trade marked and free from warp.
 - 2. Submit letter from treatment plant certifying that chemicals and process used and net amount of salts retained are in conformance with specified standards
 - 3. Submit letter certifying that fire-retardant treatment materials comply with requirements herein stated and local authorities having jurisdiction and that treatment will not bleed through finished surfaces.

1.6 QUALITY ASSURANCE

- A. Lumber Standard:
 - 1. Comply with U.S. Dept. of Commerce Product Standard PS 20, including moisture content and actual sizes related to indicated nominal sizes.
 - 2. Comply with Standard Grading Rules No. 16 for West Coast Lumber.
 - 3. Comply with American Softwood Lumber Standard and with application grading rules of inspection agencies certified by American Lumber Standard Committee's (ALSC) Board of Review.
 - 4. Comply with lumber producer's inspection agency grading rules certified as conforming to "National Grading Rules for Dimension Lumber" established under Section 10 of PS 20 and local code standard.
- B. Plywood Standard: Comply with U. S. Product Standard PS 1-74/ANSI A199.1; and Grades and Specifications, Performance-Rated Panels and Specifications by APA – The Engineered Wood Association local code standard. Each construction and industrial panel shall bear APA trademark and appropriate identification.
- C. Mat-Formed Particleboard: Comply with ANSI A208.1. Provide particleboard bearing NPA grade marking.
- D. Lumber: Factory-mark each piece of lumber with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying agency, grade, species, moisture content at time of surfacing and mill.
 - 1. Seasoning: Kiln-dry lumber to 15 - 19 percent moisture content, well-seasoned, grade marked, trade marked and free from warp.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Inspect wood materials for conformance to specified grades, species, and treatment at time of delivery to Project site.
 - 1. Reject and return unsatisfactory wood materials.
- B. Provide facilities for handling and storage of materials to prevent damage to edges, ends and surfaces.
- C. Keep carpentry materials dry.
 - 1. Store lumber and plywood in stacks with provision for air circulation within stacks.
 - 2. Protect bottom of stacks against contact with damp surfaces. Protect exposed materials against weather.
 - 3. Stack materials minimum 12 inches off ground, or if on concrete slab-on-grade, minimum 1-1/2 inches, fully protected from weather.
 - 4. Provide for air circulation within and around stacks and under temporary coverings.

- D. Place spacers between each bundle of pressure treated materials treated with waterborne chemicals to provide air circulation.

1.8 PROJECT CONDITIONS

- A. Environmental Impact: Products containing following materials will not be permitted:
 - 1. Urea Formaldehyde.
 - 2. Chromium in wood pressure treatment products.
 - 3. Arsenic.

1.9 COORDINATION

- A. Coordination: Fit carpentry work to other work; scribe and cope as required for accurate fit, show location of furring, nailers, blocking, grounds and similar supports to allow attachment of other work.
 - 1. Coordinate work directly with other subcontractors as necessary to insure proper fitting, joining or to clearances of other work. Obtain templates as required to insure proper fitting.

PART 2 PRODUCTS

2.1 LUMBER

- A. Dimensional lumber: WCLIB and WWPA grading, Douglas Fir, Larch No.1.
- B. Studs: WCLIB and WWPA grading, Douglas Fir, Larch No.2.
- C. Posts: WCLIB and WWPA grading, Douglas Fir, Larch No.1 or better.
 - 1. For posts 5 inch nominal and larger, provide material that is free of heart centers.
- D. (WD BLKG) Miscellaneous Lumber: Lumber for support or attachment of other construction, including rooftop equipment curbs and support bases, cant strips, bucks, nailers, blocking, furring, grounds, stripping and similar members.
 - 1. Moisture content of 19 percent maximum for lumber items not specified to have wood preservative treatment.
 - 2. Grade: No. 3 or standard grade.
- E. Manufactured wood I-joists shall have minimum 2x4 nominal chord members.
- F. Wood in contact with concrete shall be pressure treated Douglas Fir.

2.2 WOOD SHEATHING

- A. Provide materials that do not contain added urea formaldehyde.
- B. Sheathing: Subfloor, Roof, Wall: APA rated, thickness, grade and exposure as noted on Drawings.

2.3 BUILDING PAPER

- A. (BP) No.15 Asphalt-Saturated Felt: ASTM D226 Type I (11.5 to 12.5 lbs.), non-perforated.

2.4 PRESERVATIVE TREATMENT

- A. Ammoniacal, or amine, copper quat ACQ: AWPAC22-92.
- B. (PPT-1) Extent of Treatment:
 - 1. Wood nailers and blocking in contact with cementitious materials.
 - 2. Plywood at parapets
- C. Coat cut surfaces after treatment with brush coat of same preservative treatment. Allow preservative to dry prior to placing members.

2.5 FIRE-RETARDANT TREATMENT

- A. (FRT) Fire Retardant Treatment: Pressure impregnation with fire-retardant chemicals.
- B. Lumber and Plywood Treatment:

1. Each piece to bear:
 - a. UL FR-S rating (flame spread and smoke developed less than 25),
 - b. Complying with extended 30-minute tunnel test, ASTM E84 or UL 723
 - c. Meet interior Type A requirements in AWPA Standard C-20 for lumber and C-27 for plywood.
 - d. And shall be registered for use as a wood preservative by the U.S. Environmental Protection Agency.
 2. Treatment to provide protection against:
 - a. Termites,
 - b. Fungal decay
 3. Treatment to be free of:
 - a. Hologens
 - b. Sulfates,
 - c. Ammonium phosphate,
 - d. Formaldehyde.
- C. After treatment: Material shall be dried to an average moisture content of 15 percent or less for plywood and 19 percent or less for other lumber.
- D. Complete fabrication prior to treatment to minimize cutting and jointing after treatment.
1. Coat surfaces cut after treatment with heavy brush coat of same fire-retardant chemical.
- E. Do not use twisted, warped, bowed or otherwise damaged or defective pieces.
- F. Extent of Treatment: Wood materials as part of fire-rated assemblies shall be fire retardant treated, and as indicated, with (FRT-1).

2.6 ROUGH HARDWARE, FASTENERS AND ANCHORAGE DEVICES

- A. Extent: Provide rough hardware required, including nails, screws, bolts, lag screws, cinch anchors, toggle bolts, shot anchors and similar items.
- B. General: Provide proper size and type for use intended and for materials to be fastened.
1. Install adequate hardware to insure substantial and positive anchorage.
 2. Use galvanized for exterior locations and high humidity locations and treated wood, plain finish for other interior locations.
 3. Fasteners, hangers and bearing plates used on or in connection with treated wood shall comply with IBC 2304.9.
- C. Nails: Conform to materials standards established under FS FF-N-105.
1. At exterior work, use galvanized steel nails.
 2. Refer to IBC Nailing Schedule for quality and size.
- D. Anchor bolts to be spaced at 48" centers maximum at exterior walls.
- E. Wood in contact with concrete shall be pressure treated Douglas Fir.
- F. Anchor bolts passing through pressure treated plates shall be galvanized. Use mechanical galvanizing meeting ASTM B695, class 55 or hot dipped galvanizing meeting ASTM A153
- G. Washers, nails, and other fasteners into pressure treated plates shall be hot dipped galvanized.

2.7 ROOF VENTS

- A. (RV) Soffit Vents: Aluminum soffit vents and strips with screens and baffles vents as indicated.
1. Width: As indicated
 2. Open Area: 50 percent

2.8 TAPES, SEALANTS AND MISCELLANEOUS

- A. Adhesive: As recommended by manufacturer of product to be applied for surface material to give permanent adhesion, with material remaining flat to back surface. Comply with local code standards.
1. Comply with APA AFG-01 for adhesive for use with type of construction panel indicated.

2. Exterior: Phenolic resin waterproof glue.
 3. Interior: Water-resistant casein and other adhesives suited for particular use.
- B. Expansion Material: Use where expansion joint material is indicated and not installed under other sections.
- C. Concealed Sealants: Polyisobutylene sealant
- D. Soft Gasket or Urethane Insulation:
1. Flexible semi- closed cell urethane.
 2. Provide 1/2 inch thicker than joint where foam tape, foam gasket and urethane insulation is indicated and not provided under other sections.
 3. Location: At gaps between framing and other materials.
- E. Expanded Closed-Cell Filler (ECCF):
1. Flexible closed-cell sponge rubber, with blend of neoprene, EPDM, and SBR.
 - a. Compression/Deflection at 25 percent deflection: 2 to 5 pounds per square inch.
 - b. Elongation: 150 percent.
 - c. Ultimate tensile strength: 75 pounds per square inch.
 2. Field cut to thickness, width, and length where foam tape, foam gasket and urethane insulation is indicated and not provided under other sections.
 3. Location:
 - a. Expansion joint filler in masonry and concrete.
 - b. Filler support sealant in traffic bearing joints.
 - c. Gaps between open web joists or beams and gypsum board surfaces.
- F. Sill Sealer Gaskets:
1. Glass-fiber resilient insulation, fabricated in strip form for use as a sill sealer.
 2. Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 EXECUTION

3.1 NAILERS, BUCKS, CANT STRIPS

- A. Install plumb, level, true and square to dimensions shown and required. Allow for finishes and proper clearances where necessary.
- B. Provide sound bearing, square cuts, and full bearing surfaces. Set crown up for horizontal members. Shim and block where required.
- C. Eliminate crooked, twisted, cupped or bowed framing where required.
- D. Anchorage: Adequately anchor, fasten and support members to form secure, substantial and accurate anchorage and to hold required dimensions and prevent twist.
 1. Use bolts and screws to eliminate loosening up of joints, sagging or similar movement.
 2. Use nailers for securing gravel stops, cornices, and where otherwise shown or required.

3.2 FURRING, STRIPPING, GROUNDS AND BACKING

- A. Install plumb, level, true and square. Anchor substantially for permanent installation. Set and shim to straight edge so finish wall is true and straight.
- B. Provide grounds and backing as shown or required. Blocking as required or shown on drawings for plumbing fixtures, brackets, drapery rods, window and door frames, built-in furniture and other woodwork, both interior and exterior.
- C. Allow for finishes and shim out to form level surfaces. Verify ground sizes and locations before installation.

3.3 INSTALLATION OF SHEATHING

- A. Install plywood in accordance with Plywood Construction Guide by APA – The Engineered Wood Association.

- B. Place roof and wall sheathing with end joints staggered. Secure sheets over firm bearing.
 - 1. Maintain minimum 1/16 inch and maximum 1/8 inch spacing between joints on walls. Place perpendicular to framing members.
- C. Comply with roofing manufacturer's requirements for sheathing attachments.

3.4 SUBFLOORING

- A. Place subflooring with end joints staggered. Secure sheets over firm bearing. Maintain surface flatness of maximum 1/8 inch in 10 feet or more.

3.5 PARTICLEBOARD

- A. Where acceptable to governing authorities, particleboard may be used for subfloor, wall and roof sheathing, and stair treads in lieu of plywood.
- B. Install particleboard in accordance with appropriate National Particleboard Association installation recommendations.
- C. Seal edges of particleboard at damp and humid areas.

3.6 FACTORY WOOD TREATMENT

- A. Shop pressure treat and deliver to site ready for installation, wood materials requiring UL fire rating or pressure impregnated preservatives.
- B. Provide UL approved identification on fire resistant treated materials.
 - 1. Deliver fire retardant treated materials cut to required sizes so as to eliminate necessity of field cutting.
- C. Ensure exposed materials requiring stain or paint finish do not exceed 15 percent moisture content before applying wood preservative treatment.

3.7 SITE TREATMENT OF WOOD MATERIALS

- A. Apply preservative treatment in accordance with manufacturer's printed instructions.
- B. Brush apply 2 coats of preservative treatment on wood in contact with cementitious materials and roofing and related metal flashings. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.
- D. Ensure exposed materials requiring stain or paint finish do not exceed 15 percent moisture content before applying wood preservative treatment.

END OF SECTION

SECTION 062010 SITE CARPENTRY

PART 1 GENERAL

1.1 DESCRIPTION:

- A. Provide all labor, equipment and materials for the installation of site carpentry, including but not limited to fences, header boards and deck as shown on the drawings and specified.

1.2 REFERENCES

- A. American Society for Testing and Materials (ASTM):
 - 1. ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 2. ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 3. ASTM D1761 Standard Test Methods for Mechanical Fasteners in Wood.
 - 4. ASTM D1037 Standard Test Methods for Evaluating Properties of Wood-Base Fiber and Particle Panel Materials.
- B. Federal Specifications (FS):
 - 1. FS FF-S-111D Screws, Wood.
 - 2. FF-S-325 Expansion Shields.
- C. American National Standards Institute (ANSI):
 - 1. ANSI B18.2.1 Square and Hex Bolts and Screws, Inch Series.
- D. International Code Council (ICC):
 - 1. ICC Report ESR 1190, Wood-Polymer Composite Lumber.
 - 2. California Building Code (CBC)

1.3 QUALITY ASSURANCE

- A. Douglas Fir: As graded by a certified grading agency approved by the USDA American Lumber Standards Committee.
- B. Cedar: As graded by a certified grading agency approved by the USDA American Lumber Standards Committee.
- C. Redwood: "Standard Specifications for Grades of California Redwood Lumber" graded under the rules of the Redwood Inspection Service.
- D. Lumber: Grade stamp to contain symbol of grading agency, mill number of name, grade of lumber, species of species grouping or combination designation, rules under which grades, where applicable, and condition of seasoning at time of manufacture.
 - 1. Softwood Plywood: Appropriate grade trademark of the American Plywood Association.Type, grade, class and Identification Index.
 - 2. Inspection and testing agency mark.
- E. Pressure Treatment of Wood: In accordance with the American Wood Preservers Institute (AWPI) Standards.
- F. Glue Laminated Members: Stamp each glued laminated member with an identifying number and furnish certificates of inspection to show grade and species of lumber, slope of grain, type of glue and any other pertinent information for each member.

- G. Poles and Posts: Shall conform to American National Standards Institute specifications and dimensions for wood poles 05.1-1972, and poles shall be selected for uniformity and appearance with maximum taper of 1-inch per 10 linear feet.
- H. Preservative-treated Lumber: Lumber shall be pressure-treated for "Below Grade Use" in conformance with AWWA Standard C-2.
- I. Abbreviations: AD - air dried. KD - kiln dried. VG - vertical grain. FG - flat grain. RWD - redwood. DF - Douglas Fir. PT - pressure-treated. All wood surfaced, four sides, unless otherwise designated "rough".

1.4 PROTECTION

- A. Lumber shall be stored in neat stacks at the site unless it is to be used immediately. All lumber shall be piled so that it may be readily inspected and shall be handled in a manner that will avoid injury or breakage.
- B. Immediately upon delivery to jobsite, place materials in area protected from weather.
- C. Take special care when handling.
- D. Store lumber on a flat surface with skids above ground as necessary to prevent warping.
- E. When stacking palletized units, start supports at each end and spaced 24" o. c.
- F. Line up supports vertically.

1.5 SUBMITTALS

- A. Submit listed submittals in accordance with Section 013300.
- B. Submit Wood Composite Lumber manufacturer's product data and installation instructions including details of anchors, hardware and fasteners.
- C. Submit selection and verification samples of Wood Composite Lumber decking in color and thickness as specified.
- D. Certifications
 - 1. Pressure-treated wood: Submit certification by treating plant stating chemicals and process used, net amounts of slats retained, and conformance with applicable standards.
 - 2. Submit manufacturer's certificate decking products meet or exceed specified requirements.

PART 2 MATERIALS

2.1 LUMBER

- A. Except where otherwise noted, all lumber shall conform to the allowable characteristics permitted within the applicable grading rule. No splits, checks, holes, decay or other irregularities will be permitted except characteristic of that grade.
- B. Lumber shall be as follows:
 - 1. Unless otherwise indicated on drawings or specified, lumber shall be Construction Heart Redwood.
 - 2. Pressure Treated Lumber for Deck support structure: Douglas fir-Larch, No. 1, pressure-treated as noted below.
 - 3. Redwood, Construction Heart, S4S and better.
 - 4. Bench and fascias shall be Redwood, Clear Heart, S4S.
 - 5. Douglas fir-Larch shall be pressure-treated No. 1 common grade or better, S4S.
 - 6. Posts shall be pressure-treated, Douglas fir-Larch, and sized as indicated on the Drawings. Pressure treat Douglas fir with "ACQ". Treat all posts for "below ground use" (.60 lbs. per cubic foot) in conformance with AWWA requirements.

7. Pressure Treated Lumber shall be incised on all sides unless shown otherwise.
8. Plywood, CDX, planed finish, 3/4" thickness.

2.2 PRESERVATIVE-TREATED LUMBER CONNECTOR SCREWS

- A. Self-taping galvanized flat head deck screws

2.3 REDWOOD HEADER BOARD

- A. Wood Header Board: All Rough Construction Heart Redwood 2x4 with 2x4x15" Redwood stakes, 2x4 scab splices at point of curvature, and doubled 1x in curved sections.

2.4 ACCESSORIES

- A. All hardware used to fasten onto Preservative-treated Lumber shall be galvanized steel.
- B. Hardware: Provide all necessary nails, screws, clips and bolts required for proper installation of wood and wood composite lumber decking. Sizes and quantities as required by code authority having jurisdiction, unless more stringent requirements specified elsewhere.
 1. Bolts, Exterior Use:
 - a. Material Standard: Comply with ASTM A307, with standard washers.
 - b. Finish: Galvanized, ASTM A123.
 - c. Size: As shown.
 2. Lag Screws:
 - a. Material Standard: Comply with ANSI B18.2.1.
 - b. Finish: Hot dipped galvanized for exterior use.
 3. Expansion Shields:
 - a. Material Standard: Comply with Fed Spec. FF-S-325, Type 1, Group III, Self-drilling.
 4. Nails, General:
 - a. Material Standard: Comply with ASTM F1667.
 - b. Type: Common unless otherwise indicated.
 - c. Finish: Hot dipped galvanized for exterior use.

2.5 PRESERVATIVE

- A. Preservative-treated Lumber shall be pressure-treated for "Below Grade Use" with ACQ, 0.60 retention, in conformance with AWPA Standard.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions:
 1. Verify that site conditions are acceptable for installation of materials.
 2. Do not proceed with installation of wood and wood composite lumber until unacceptable conditions are corrected.

3.2 INSTALLATION

- A. Workmanship shall be first class throughout. All lumber (except Wood Composite Lumber) shall be accurately cut and framed to a close fit and shall have even bearing over the entire contact surface. All joints shall be square and tight unless otherwise shown. No shimming will be permitted in making joints. Work shall be free of hammer marks, dents or other disfiguration. Nails and other hardware to be sized per U.C.B. Nailing Schedule and to be seated flush unless otherwise shown. Counter-sink finishing nails 1/16 inch. Holes for bolts shall be bored with a bit 1/16 inch larger than the bolt. Holes for lag screws shall be bored with a bit not larger than the base of the thread (75% of the diameter).

- B. Lumber Selection: Select individual pieces so that knots and obvious minor defects will not interfere with connections.
- C. Install members with crown and tight knots up.
- D. Cut joists, rafters and beams as required to provide a full even and horizontal seating on the support, unless otherwise shown, do not overcut.
- E. Do not use lumber with end splits greater than the following:
 - 1. Joists 2x: Split length greater than 1/2 the wide face of the member.
 - 2. Beams and headers: Split length greater than thickness of member.
 - 3. Structural blocking: Split length greater than thickness of member.
- F. Limit notches and bored holes in joist and beams as follows:
 - 1. Not permitted unless detailed on the Drawings or approved by the Structural Engineer.
 - 2. Notches in bottom or in top at cantilever or continuous span not permitted.
 - 3. Notches in top shall not exceed 1/6th the depth and shall not be located in the middle 1/3 of span.
 - 4. Bored holes shall not exceed 1-1/2" nor 1/5 of the depth in diameter, and shall not be within 2" of top or bottom.
- G. Fastening:
 - 1. Use such fastenings and connections as required to connect members securely together or to structure.
 - 2. Minimum nailing, not otherwise shown or noted, shall conform to CBC Table 2304.9.1.
 - 3. Penetration of nails or spikes into piece receiving point shall be not less than 1/2 length of nail or spike, except, that 16 penny nails may be used to connect pieces of 2" thickness.
 - 4. Drive nails and spikes no closer together than 2/3 their depth nor closer to edge of member than 1/4 their depth.
 - 5. Place nails, bolts and other connector without splitting wood.
 - 6. Pre-drill holes whenever nailing tends to split wood. Replace all split members.
 - 7. All nuts and screws shall be tightened when placed and retightened at completion of the job or immediately prior to closing in.
 - 8. Nuts shall be secured against loosening.

3.3 PRESERVATIVES:

- 1. Apply specified preservative to all wood in contact with ground (including framing for deck). Moisture content of wood at time of application shall not exceed 25%. When any framing, cutting or boring of treated wood (field cuts) is performed after treatment, swab all cuts, dips and holes thoroughly with heavy application of the same preservative specified for the treatment of the lumber. Install cut end above grade only.
- 2. Bolts 5/8" and less in diameter shall be fitted with cut washers, and all bolts and lag screws over 5/8" in diameter shall be fitted with cast or malleable iron washers unless otherwise shown on the Drawings. Select bolt length to fit situation. Where bolts project beyond nut, cut off to a point 1/8" from nut and paint same day with heavy coat of Zinc Chromate primer paint and one coat of Aluminum finish paint (to match the galvanized bolt finish, unless otherwise noted). Bolts to be hot dip galvanized.
- 3. Stainless steel hardware with stainless steel screws and bolts may be used in lieu of hot dip galvanized. Do not mix stainless steel with galvanized steel hardware.
- 4. Exposed nails in exterior work shall be hot-dipped galvanized except where specified otherwise.

3.4 RECYCLED PLASTIC LUMBER HEADER BOARD:

- A. Do not install headers until Owner's Representative has approved finish grades.
- B. Comply with the instructions and recommendations of the recycled lumber manufacturer. Follow chart for maximum crown length and Height.

- C. All headers to be set to required line and grade. Curves to be clean, smooth and continuous. Where minimum curves are required, headers may be laminated and nailed in a staggered pattern at a maximum of eighteen inches on center (18" o.c.) with nails clinched over. Laminated portion to lap into straight section eight feet (8'). Splices to lap by four feet (4').
- D. Do not screw through slip joint. Use plated screws or ring shank nails to join boards to stakes. Allow for thermal expansion and contraction by leaving gaps in the slip joints and at the end of the run. Installation during hot weather install minimum gap and during cool weather install maximum gap.
- E. Headers to be spliced with scabs trimmed to three-quarters of an inch (3/4") below top of header. Multi-cuts into header for bending is not acceptable.
- F. Stakes to be placed a maximum of three feet on center (3' o.c.) and at all joints, splices and ends. Stakes to be trimmed to three quarters of an inch (3/4") below top of header.
- G. Scabs and stakes to be nailed and nails clinched over.
- H. Provide 1/2" gap at but joints for expansion.
- I. Headers installation shall be approved by the Owner's Representative before adjacent materials are laid.
- J. Before paving or other material is laid, headers shall be backfilled for support.
- K. It shall be the responsibility of the Contractor to protect the header boards during the construction work. Any headers damaged by equipment shall be replaced by Contractor at his expense.

3.5 WOOD HEADER BOARDS

- A. Provide Construction Heart Redwood header boards as shown and specified with stakes at 4' on center max and at all joints. Provide laminated doubled 1 by header boards in curved portions with 2 by RWD scab splice connection at point of curvature. Headers may be laminated and nailed in a staggered pattern at a maximum of eighteen inches on center (18" o.c.) with nails clinched over. Laminated portion to lap into straight section eight feet (8'). Splices to lap by four feet (4')

3.6 PROTECTION

- A. Protect installed work from damage due to subsequent construction or other activity on the site.

END OF SECTION

SECTION 064000 ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Custom fabricated, milled cabinetwork for specially designed units.
 - 1. Wood and wood veneer cabinetwork, including:
 - a. Base cabinets, wall cabinets, wall shelving with standards and brackets.
 - 2. Laminate clad cabinetwork, including:
 - a. Base cabinets, wall cabinets, countertops with backsplashes.
 - b. Plastic laminate wall shelving with standards and brackets.
 - 3. Cabinet hardware and accessories.
 - 4. Preparation of cabinetwork for utilities.
 - 5. Prefinishing of woodwork.
 - 6. Solid surfacing.
- B. Related Sections:
 - 1. Section 055000 - Metal Fabrications: Metal supports for woodwork.
 - 2. Section 061000 - Rough Carpentry.
 - 3. Section 079000 - Joint Protection.
 - 4. Section 081400 - Wood Doors.
 - 5. Section 088000 - Glazing: Sliding glass doors and glass shelves
 - 6. Section 096500 - Resilient Flooring: Resilient base.
 - 7. Division 22 – Plumbing.
 - 8. Division 26 - Electrical.

1.2 REFERENCES

- A. AWS - Architectural Woodwork Standards Adopted and Published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturer's Association of Canada and Woodwork Institute - Current Edition.
- B. Design Guide for the Built Environment of Behavioural Health Facilities, Edition 7.0, FGI & NAPHS

1.3 SYSTEM DESCRIPTION

- A. Prefabricated, shop-assembled casework and custom fabricated milled cabinetwork, work surfaces and accessories for specially designed units. Furnished and installed under single source responsibility.
- B. Custom fabricated, milled cabinetwork for specially designed units.
 - 1. Where custom woodwork is identified by code numbers, provide individual modular units with custom items as indicated. Where custom designed units occur in conjunction with base and upper cabinets, this Work is to be provided under this Section.
 - 2. Where casework is designated by code numbers, provide individual modular units as indicated, provide as single fabrication containing the features of individual modular units.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate dimensions, descriptions of materials and finishes, general construction, specific modifications, component connections, anchorage methods, hardware, and installation procedures, including specific requirements where indicated.
 - 1. Show work in related and dimensional position with sections shown in not less than 1-1/2 inch scale and details at full size.
 - 2. Indicate materials and wood species, component profiles, fastening, jointing, details, finishes and accessories.
 - 3. Indicate locations of plumbing and electrical service field conditions.

- B. Samples: Submit samples of factory finish on wood veneer and factory finish on solid wood in accordance with AWS. Submit samples of finish on high pressure laminate for color and finish selection.
 - 1. Component Samples: Two sets of samples in 8 inch by 10 inch size, unless otherwise indicated, for each of the following items:
 - a. High pressure laminate for color and texture/finish selection.
 - b. Each wood veneer with shop applied finish.
 - 1) 5 inch by 24 inch.
 - c. Worksurface for color and texture/finish (other than plastic laminate).
 - d. Grommets for color.
 - e. Thermoset decorative overlays.
 - f. Hardware sample for appearance.
 - g. Work surface for appearance review.
 - 2. Unit Samples: Units may be used as part of work if approved.
 - a. Cabinetwork base (with door and drawer) without countertop.
 - b. Cabinetwork wall unit with door.
- C. Quality Assurance Submittals:
 - 1. Manufacturer/fabricator qualifications.
 - 2. Humidity and temperature reading taken before, during and after installation.

1.5 QUALITY ASSURANCE

- A. Quality Standards: Comply with Architectural Woodwork Standards.
 - 1. Lumber: Softwood - PS-20, hardwood - FSMM-L-736C, AWS Premium Grade, species as specified. Maximum moisture content of 10 percent.
 - 2. Plywood: Softwood - PS-1/ANSI A199.1, hardwood - AWI Premium Grade species as specified.
- B. Fabricator's Qualifications: Not less than 5 years experience in the actual production of specified products.
 - 1. Meeting or exceeding qualifications in Part 2.
- C. Field Measurements: Where woodwork is indicated to fit to other construction, verify dimensions of other construction by field measurement before fabrication and indicate measurements on shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.
 - 1. Locate concealed framing, blocking, and reinforcements that support woodwork by field measurement before being enclosed and indicate measurements on shop drawings.
- D. Monitor and record temperature and humidity before, during and after installation.

1.6 DELIVERY, HANDLING AND STORAGE

- A. Environmental Limitations: Comply with recommendations of AWS. Do not deliver or install architectural woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

1.7 COORDINATION

- A. Coordinate work directly with other subcontractors as necessary to insure proper fitting, joining or to clearances of other work.
 - 1. Obtain templates as required to insure proper fitting.
 - 2. If required, do not install or close up areas of cabinetwork until utilities have been installed.
 - 3. Verify electrical and mechanical characteristics with other subcontractors, and exchange shop drawings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fabricate millwork to meet quality requirements of current AWS and by well-established and experienced firm, acceptable to Owner and Architect, with satisfactory record of similar size and quality installations.
 - 1. Fabricator must demonstrated capability to produce quality required within time required for completion and demonstrate:
 - a. Adequate shop capacity.
 - b. Required experience of workers.
 - c. Equipment or supply of material.
 - d. Previous performance has been satisfactory.
 - e. Ability to meet or exceed AWS quality standards fabrication requirements

2.2 MATERIALS AND QUALITY GRADES

- A. Quality Standards: Materials and workmanship of woodwork shall comply with Custom Grade requirements of AWS, (except countertops shall comply with Premium Grade).
- B. Wood Moisture Content: 5 to 10 percent.
- C. Interior Work for Transparent Factory Finish:
 - 1. (WD) Species for solid and veneer hardwood: As selected by Architect.
- D. Interior Work for Paint Finish:
 - 1. Species for paint finish: Natural Birch.

2.3 FABRICATION - GENERAL

- A. Fabricate Work of this Section using materials, methods and quality control procedures necessary for installed units to withstand dimensional changes that can be expected resulting from temperature and humidity variations at project location when interior spaces do not have humidity control. Seal each surface to help mitigate dimensional change resulting from temperature and humidity variations.
- B. Fabricate in accordance with approved shop drawings.
- C. Provide cutouts properly located and sized to accommodate Work provided by other Related Sections.
 - 1. Provide, where not otherwise indicated or concealed, moldings to cover exposed core of veneered work. Provide proper mountings for hardware, including snuggers, catches.
 - 2. Provide cutouts and holes for items such as sinks, fittings, risers, ducts, and other features furnished into work of this section.
 - 3. Where it may not be practical to precut holes and where coordination with field features may be uncertain or difficult, holes and openings shall be field cut and sealed.
 - a. Sinks by Mechanical, Division 22.
- D. Assemble work in mill as much as possible. If necessary to insure best results, complete units shall be assembled in mill and then partially disassembled into workable sections for shipping and project installation.
 - 1. When installing items not shop assembled, distribute defects to best overall advantage allowed by specifications.
 - a. Necessary joints for shipping shall be approved type.
 - 2. Shop fabricate wall-mounted shelving out of plywood when spanning over 30 inches.

2.4 WOOD CABINETWORK FABRICATION

- A. Grade: AWS Custom Grade for transparent finish prefinishing except provide drawer fronts with vertical grain to sequence with vertical door grain unless otherwise allowed.
- B. Face construction: Provide flush type cabinetwork, unless indicated otherwise.
 - 1. Species for solid or veneered hardwood (WD).

2. Species for semi-exposed wood veneer: Fir plywood with hardwood edge.
3. Provide dust panels above compartments and drawers, except when located directly below countertops.
4. Hardboard: Prefinished wood fiber hardboard with smooth faces, tempered both sides with putty color opaque polyester overlay.

2.5 PLASTIC-LAMINATE-FACED CABINETS & COUNTERTOPS

- A. Minimum Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.
 1. Cabinets: Custom Grade.
 2. Countertops: Premium Grade.
 3. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.
- B. PLAM Cabinets:
 1. Type of Construction: Frameless.
 2. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
 3. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.
 4. Exposed Horizontal and Vertical Surfaces and Edges: Grade HGS.
 5. Semi-Exposed Surfaces (Other than Drawer Bodies):
 - a. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.
 - 1) Medium-Density Fiberboard: ANSI A208.2, Grade 130 made with binder containing no urea formaldehyde.
 - 2) Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
 6. Semi-Exposed Backs of Panels: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
 7. Concealed Backs of Panels: High-pressure decorative laminate, NEMA LD 3, Grade BKL.
 8. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.
 - a. Join subfronts, backs, and sides with glued dovetail joints.
 - b. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
 - c. Drawer Bottoms: Thermoset decorative panels.
- C. PLAM Countertop: High Pressure Decorative Plastic Laminate clad, Premium Grade.
 1. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS ; post forming grade (0.039" thick) High Pressure laminate counter top
 2. Edge Treatment: Post-formed.
 3. Backsplash:
 - a. Integral, coved backsplash.
 - b. Butted splashback, typical.
 4. Coreboard for Countertops: Medium-density fiberboard made from 100% recycled fiber meeting ANSI 208.2 standards, ASTM D1037 2, Grade 2-M-2 and HUD 24 emission standards (formaldehyde free).
 5. Core Thickness: Nominal 1-inch.
 6. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.

2.6 CABINET HARDWARE

- A. Hinges:
 1. Fixed pin, five knuckle steel hinges, dull chrome, 2-3/4 inch by 0.095 thick. BHMA A156.9, B01361.
 2. Provide Anti-ligature hinges in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and all areas of the ARF and MHRC.

- a. Sloped top hinges.
 - b. Heavy duty, institutional grade.
 - c. Tamper resistant fasteners.
- 3. Concealed Hinges: Concealed, all-metal hinges, 110 degree opening (unless otherwise noted) self-closing, 3-way adjustable.
 - a. Provide 3 per leaf over 48 inches high, 2 per leaf elsewhere. BHMA A 156.9 B01602.
 - b. Provide quiet soft-cushion closers.
- B. Shelf Supports: Provide at adjustable shelves in cabinetwork.
 - 1. Shelf Supports: Pin size 1/4 inch diameter by 3/8 inch long.
- C. Drawer Slides: Cold rolled steel, zinc plated with positive stop and full extension. Rolling steel balls, nylon rollers meeting or exceeding requirements below:
 - 1. (HDWR-S1): Minimum 75 lb. load rating.
 - 2. (HDWR-S2): Minimum 100 lb. load rating.
 - 3. (HDWR-S3): Minimum 150 lb. load rating.
- D. Door and Drawer Pulls:
 - 1. (HDWR-P1): 4 inch wire pull, dull chrome.
 - 2. (HDWR-P2): Recessed cabinet pull, with no protruding openings or of a closed type.
 - a. Provide Anti-ligature hinges where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Heavy duty, institutional grade.
 - c. Tamper resistant fasteners.
- A. Locks: Cylinder lock keyed and master-keyed.
 - 1. Review final keying sequences with Owner.
 - 2. Provide at hinged doors and drawers, where indicated.
 - a. Provide Anti-ligature locks where indicated AND at every moving piece of millwork:
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Heavy duty, institutional grade.
 - c. Tamper resistant fasteners.
- B. Keyless Cabinet Lock:
 - 1. Heavy-duty electronic keyless cabinet lock, door thickness at 1/8 inches up to 1-1/8 inches, battery operated, stainless steel finish, dimensions: 5-3/8" (L) x 1-5/8" (W) x 1-1/2" (D).
- C. Counter Brackets: L-bracket profile, 5mm thick steel bar with 3/4 inch steel strut, holds 1000 lb. per pair, finish in epoxy coated finish in color as indicated or selected by Architect.
- D. Work Station Brackets: 1/8 inch steel; 1-1/2 inch forms with multiple 1/4 inch mounting holes per side; reversible; color as chosen by Architect from manufacturer's standard colors.
 - 1. Sizes as required by application: 24 inch by 29 inch, 18 inch by 24 inch, 15 inch by 21 inch (with 3 inch by 3 inch notch for wall cleat and wire run) or 8 inch by 12 inch.
 - 2. Capacity: 1,000 pounds minimum.
- E. Steel Tubing: ASTM A501 or ASTM A500, 1-inch by 1-inch steel tubing, 12 ga., primed white.
- F. Steel Barstock: ASTM A36, in sizes and shapes as shown on Drawings.
- G. Install hardware, supports and accessories in Anti-ligature arrangement where indicated AND
 - 1. in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2. all areas of the ARF and MHRC.
 - 3. Heavy duty, institutional grade spaced or sized to resist dynamic loading by bariatric patients up to 1,000lbs.
 - 4. Tamper resistant fasteners.

2.7 SHELVES

- A. Non-adjustable shelves for Patient Room wardrobe cabinets, where indicated AND

- B. Provide and install shelves, hardware, supports and accessories in Anti-ligature arrangement where indicated AND
1. in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 2. all areas of the ARF and MHRC.
 3. Heavy duty, institutional grade spaced or sized to resist dynamic loading by bariatric patients up to 1,000lbs.
 4. Tamper resistant fasteners.
- C. Adjustable Shelf Standards and Brackets:
1. Typical Standards.
 2. Janitor Shelf Standards and Brackets: Heavy duty 14 inch bracket and standards. Provide for 3 shelves, with 9 brackets.
 3. Space standards not over 32 inches on center. Where length of standards cannot be determined from drawings, assume shelves are spaced 12 inches on center vertically, and add 12 inches to shelf spacing and furnish next larger stock size.

2.8 SOLID SURFACING

- A. Counters (SSF): Where indicated, provide top with coved backsplash.
1. Cast polymer 1/2-inch sheet.

- B. Performance Properties:

<u>Property</u>	<u>Typical Results</u>	<u>Test Method</u>
General:		
Thickness Tested:	0.500"	
Specific Gravity	1.6	ASTM D-792
Water Absorption (24hrs.)	0.04%	ASTM D-570
Mechanical:		
Tensile Strength	4,000 psi	ASTM D-638
Tensile Modulus	1,100,000 psi	ASTM D-638
Tensile Elongation	2.1%	ASTM D-638
Flexural Strength	8000 psi	ASTM D-790
Flexural Modulus	1,100,000 psi	ASTM D-790
Barcol Hardness	60	ASTM D-2583
Rockwell Hardness	86	ASTM D-785
Un-notched Izod Impact	1.40 ft.lbs./inch	ASTM D-4812
Notched Izod Impact	0.14 ft.lbs./inch	ASTM D-256
Ball Impact (1/2 lb. ball)	>150 Inches	NEMA LD3-3.8
Total Volatile Organic Compound	6.91 µg/m2/hr	ASTM-D5116
Thermal:		
DTUL @ 264 psi	200 °F	ASTM D-648
Coefficient of Thermal Expansion	2.3 X 10-5 in./in.°F	ASTM D-696
Boiling Water Resistance	No Effect	ISSFA SST 8.1-00
High Temperature Resistance	No Effect	ISSFA SST 9.1-00
Flame Spread	<25	ASTM E 84
Smoke Generation	<25	ASTM E 84
Combustion Toxicity	96 (solid colors)	Pittsburgh Protocol
Surface:		
Cleanability / Stain Resistance	Pass	NEMA LD3-3.4
Stain Resistance	Pass	ANSI Z 124.3
Consistency of Color (same sheet)	Pass	ISSFA SST 2.1-00
Light Resistance	No Effect	ISSFA SST 7.1-00
Food Zone Use	NSF 51 Approved	NSF
Fungal/Bacterial Resistance	Does not support microbial growth	ASTM G-21
HIV-Resistance	Disinfected surface does not support HIV	Protocol 61-074-1

- C. Pattern and Color: Colors and pattern as selected by Architect.

- D. Joint Adhesive: As recommended by manufacturer. Use pick-resistant sealant where indicated AND:
- E. Install sealant, gaskets, backer rods with max 8' continuous lengths or with Anti-ligature breakpoints where indicated AND
 - 1. in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2. all areas of the ARF and MHRC.
 - 3. Heavy duty, institutional grade pick resistant per referenced guidelines.
 - 4. Tamper resistant installation methods.

2.9 PREFINISHING

- A. Finish in accordance with AWS.
 - 1. Finish Grade: Premium Grade: Stain, filler, sealer and 2 top coats.
 - a. AWS System Catalyzed Polyurethane (formerly TR-6)
 - 2. Apply finish to achieve minimum 4 mil total dry film thickness.
- B. Factory finish as selected by Architect.

2.10 CABINETWORK FABRICATION

- A. Shop assemble cabinetwork for delivery to site in units easily handled to permit passage through building openings.
 - 1. Fabricate cabinetwork in accordance with reviewed shop drawings and AWS Custom Grade Standards.
- B. Strength: Join and assemble work to provide durable, strong, rigid units that will not warp or rack, including during shipping and installation.
- C. Gluing: Glue joints on surfaces. Use highest grade glue in strict accordance with manufacturer's recommendations.
 - 1. Use Type 1 waterproof glue for work exposed in any part of exterior, around sinks and at other locations where work is exposed to moisture or dampness that might affect glue bond.
 - 2. Use water-resistant glue equal to urea-formaldehyde resin glue at other locations.
- D. Corners: Ease lightly with sandpaper (do not round or bevel) corners not shown rounded.
- E. Shelves: Unless noted otherwise, adjustable and 3/4 inch thick up to 36 inch span, 1 inch thick on 36 inch - 42 inch span, minimum 1-1/8 inch thick over 42 inch span.
- F. Provide screw caps for screws used to mount cabinets on walls or attach cabinets together when screws are semi-exposed.

2.11 PLASTIC LAMINATE FABRICATION

- A. Quality Grade: high pressure laminate shall conform to Custom Grade requirements of AWS.
- B. Fabrication: Apply laminate finish in full-uninterrupted sheets consistent with manufactured sizes.
 - 1. Use cabinet liner at non-exposed surfaces, behind doors or in drawers.
 - a. Glue joints in shop, using hardwood spline, except where field joints are necessary for shipping or placing in work.
 - b. Prepare counter field joints in shop using bolt-up Tite-Joint fasteners at spacing recommended by fastener manufacturer.
 - c. Unless specifically shown otherwise, apply matching laminate to exposed edges (including back edge not tight to wall) and provide approved bevel edge at joint with face or top.
 - d. Seal core surfaces not laminate-faced with clear synthetic resin sealer recommended by laminate manufacturer.

2.12 FABRICATION OF CABINETWORK DOORS

- A. Fittings and Sizes: Trim square and factory-size to nominal opening size less approximately 1/16 inch in width and 1/8 inch in height (unless otherwise required) for final fitting.

1. Provide bottom valance on cabinets to cover under cabinet lighting where indicated, except at side of cabinet where units are gang units.
- B. Quality Grade: Except as otherwise specified herein, provide Custom Grade as defined in AWS.
- C. Guarantee: Cabinetwork doors shall be guaranteed for 3 years. Guaranty shall cover faulty workmanship, materials, delamination or splitting of veneers, or warp in excess of 1/4 inch. Replace doors complete including fitting, hanging, and finishing.

PART 3 EXECUTION

3.1 PREPARATION

- A. Material Moisture Content and Environmental Requirements: Comply with recommendations of AWS Woodwork Standards.
 1. Install work after building humidity is at acceptable level.
 2. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Woodwork Materials and Fabrications:
 1. Conditioning: Before installation, condition wood materials and cabinets to average prevailing humidity conditions in installation areas.
 2. Examine finish carpentry materials before installation.
 3. Reject materials that are wet, moisture damaged, and mold damaged.
- C. Substrates to Receive Architectural Woodwork:
 1. Examine substrates, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance.
 2. Architectural woodwork installer to approve substrate prior to installation.
 3. Proceed with installation only after unsatisfactory substrate conditions have been corrected.

3.2 INSTALLATION

- A. Install Woodwork in Anti-ligature arrangement where indicated AND
 1. in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 2. all areas of the ARF and MHRC.
 3. Heavy duty, institutional grade spaced or sized to resist dynamic loading by bariatric patients up to 1,000lbs.
 4. Tamper resistant fasteners in heavy duty arrangement to prevent removal of pieces.
 5. Sloped tops where horizontal surfaces are not required.
 6. Flush construction without protruding trim that could be used in ladder fashion.
- B. General: Installation of Woodwork shall be in accordance with AWS Quality Standards Section 1700 - Installation of Architectural Woodwork.
 1. Install woodwork fabrications and accessories according to reviewed shop drawings and manufacturer instructions.
 2. Tolerances: Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.
 3. Install free from hammer or tool marks, open joints or slivers or other defects detrimental to appearance or performance.
 4. Set plumb, level, square and true.
 5. Scribe to floors and walls as required.
 6. Miter corners, countersink nails, drill holes for nails in hardwood.
 7. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush.
 8. Ensure that mechanical and electrical items affecting this section are properly placed, complete, and have been inspected by Architect prior to commencement of installation.
- C. Solid Surfacing: Install solid surfacing in accordance with reviewed shop drawings and manufacturer's instructions.

- D. Cabinetwork:
 - 1. Install without distortion so that doors and drawers fit openings properly and are accurately aligned.
 - 2. Adjust doors, drawers, hardware, fixtures and other moving or operating parts to function smoothly and correctly.
 - 3. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation.
 - a. Maintain veneer sequence matching of cabinets with wood veneers.
 - 4. Install screw caps where required.
 - 5. Countertops: Anchor securely to base units and other support systems as indicated.
- E. Wall-Mounted Shelving and Countertops: Install standards, brackets and other supports according to manufacturer's written instructions. Fasten to framing members, wood sheathing, wood blocking or metal backing, or use toggle bolts or hollow wall anchors.

3.3 INSTALLED WOODWORK

- A. Replace interior finish carpentry that is damaged or does not comply with requirements. Interior finish carpentry may be repaired or refinished if work complies with requirements and shows no evidence of repair or refinishing. Adjust joinery for uniform appearance.
- B. Clean interior finish carpentry on exposed and semiexposed surfaces. Restore damaged or soiled areas and touch up factory-applied finishes, if any.
 - 1. Clean cabinetwork, counters, shelves, hardware, fittings and fixtures.
- C. Protect installed products from damage from weather, moisture, humidity and other causes during construction.
- D. Remove and replace finish carpentry materials that are wet, moisture damaged, and mold damaged.
 - 1. Indications that materials are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that materials are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 071326 SELF-ADHERING SHEET WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Self -adhering modified bituminous sheet waterproofing system (WP-6), including protection course and drainage panels, for vertical below-grade applications.
- B. Related Sections:
 - 1. Section 033000 - Cast-in-Place Concrete.
 - 2. Section 072100 - Thermal Insulation: Foundation wall insulation.
 - 3. Section 072670 - Moisture Barrier.
 - 4. Section 079000 - Joint Protection.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's instructions for surface conditioner compatibility, elastic flashing, joint cover sheet, and joint and crack sealants, with temperature range for application of waterproofing membrane.
- B. Product Data: Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
- C. Shop Drawings: Show locations and extent of waterproofing. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.
- D. Samples: Provide sample of waterproof membrane materials.
 - 1. 12-by-12-inch square of waterproofing and flashing sheet.
- E. Sample Warranty: Copy of special waterproofing manufacturer's and Installer's warranty stating obligations, remedies, limitations, and exclusions before starting waterproofing.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who is authorized, approved, or licensed by waterproofing manufacturer to install manufacturer's products.
- B. Pre-Installation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination." Review requirements for waterproofing, including surface preparation specified under other Sections, substrate condition and pretreatment, minimum curing period, forecasted weather conditions, special details and sheet flashings, installation procedures, testing and inspection procedures, and protection and repairs

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to Project site in original packages with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, and directions for storing and mixing with other components.
- B. Store materials in their original undamaged packages in a clean, dry, protected location and within temperature range required by waterproofing manufacturer.
- C. Remove and replace materials that cannot be applied within their stated shelf life.
- D. Store rolls according to manufacturer's written instructions.
- E. Protect stored materials from direct sunlight.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate.
 - 1. Do not apply waterproofing in snow, rain, fog, or mist.
- B. Maintain adequate ventilation during preparation and application of waterproofing materials.
- C. Weather: Proceed with waterproofing and associated work only when existing and forecasted weather conditions will permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

1.7 WARRANTY

- A. Special Manufacturer's Warranty: Written warranty, signed by waterproofing manufacturer agreeing to replace waterproofing material that does not comply with requirements or that does not remain watertight during specified warranty period.
 - 1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate exceeding 1/16 inch in width.
 - 2. Warranty Period: Five years after date of Substantial Completion.
- B. Special Installer's Warranty: Written waterproofing Installer's warranty, signed by Installer, covering Work of this Section, for warranty period of two years.

PART 2 PRODUCTS

2.1 WATERPROOFING SYSTEM

- A. Provide complete waterproofing system in accordance with waterproofing Manufacturer's written recommendations and requirements for warranty.
- B. Source Limitations: Provide waterproofing system components from single source from single manufacturer. Provide accessory products including drainage panel and protection course from sources as recommended in writing by waterproofing manufacturer.
- C. Material Compatibility: Waterproofing materials shall be compatible with one another and with adjacent work under conditions of service and application required, and as demonstrated by waterproofing manufacturer based on testing and field experience.
- D. Performance Requirements: Installed waterproofing system shall withstand thermally induced movement and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Waterproofing system shall remain watertight.

2.2 MODIFIED BITUMINOUS SHEET MEMBRANE WATERPROOFING

- A. (WP-6) Modified Bituminous Sheet Membrane: 60-mil (1.5 mm) thick, self-adhering sheet consisting of 56 mils of rubberized asphalt laminated to a 4-mil-thick polyethylene-film reinforcement, with release liner on adhesive side; formulated for application with primer or surface conditioner that complies with VOC limits of authorities having jurisdiction.
 - 1. Physical Properties:
 - a. Membrane Tensile Strength; ASTM D 412, Die C, modified: 250 psi minimum.
 - b. Ultimate Elongation; ASTM D 412, Die C, modified: 300 percent minimum.
 - c. Low-Temperature Flexibility; ASTM D 1970, at minus 20 deg F: Pass.
 - d. Crack Cycling; ASTM C 836, after 100 cycles of 1/8-inch movement: Unaffected.
 - e. Puncture Resistance; ASTM E 154: 40 lbf minimum.
 - f. Water Absorption; ASTM D 570, after 48-hour immersion at 70 deg F: 0.2 percent weight-gain maximum.
 - g. Water Vapor Permeance; ASTM E 96, Water Method: 0.05 perms maximum.
 - h. Hydrostatic-Head Resistance; ASTM D 5385: 200 feet, minimum.

- B. Concealed Strip Flashing: Self-adhering, rubberized-asphalt strips of same material and thickness as sheet waterproofing.

2.3 AUXILIARY MATERIALS

- A. Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
 - 1. Furnish liquid-type auxiliary materials complying with VOC limits of authorities having jurisdiction.
- B. Primer: Liquid waterborne or VOC compliant solvent borne primer recommended for substrate by manufacturer of sheet waterproofing material.
- C. Surface Conditioner: Liquid, waterborne surface conditioner recommended for substrate by manufacturer of sheet waterproofing material.
- D. Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity.
- E. Substrate Patching Membrane: Low-viscosity, two-component, asphalt-modified coating.
- F. Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.
- G. Metal Termination Bars: Aluminum bars, approximately 1 by 1/8 inch thick, predrilled at 9-inch centers.

2.4 INSULATION

- A. Foundation Wall Insulation: Comply with Section 072100 - Thermal Insulation for (INSUL-1).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - 1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
 - 2. Verify that concrete is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D4263.
 - 3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.
- B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.
- C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, and other penetrating contaminants or film-forming coatings from concrete.
- D. Remove fins, ridges, mortar, and other projections and fill honeycomb, aggregate pockets, holes, and other voids.
- E. Prepare, fill, prime, and treat joints and cracks in substrates. Remove dust and dirt from joints and cracks according to ASTM D4258.
 - 1. Install sheet strips and center over treated construction and contraction joints and cracks exceeding a width of 1/16 inch.
- F. Bridge and cover isolation joints, expansion joints, and discontinuous deck-to-wall joints with overlapping sheet strips.

1. Invert and loosely lay first sheet strip over center of joint. Firmly adhere second sheet strip to first and overlap to substrate.
- G. Corners: Prepare, prime, and treat inside and outside corners according to ASTM D 6135.
 1. Install membrane strips centered over vertical inside corners. Install 3/4-inch fillets of liquid membrane on horizontal inside corners and as follows:
 - a. At footing-to-wall intersections, extend liquid membrane each direction from corner or install membrane strip centered over corner.
- H. Prepare, treat, and seal vertical and horizontal surfaces at terminations and penetrations through waterproofing and at drains and protrusions according to ASTM D 6135.

3.3 MODIFIED BITUMINOUS SHEET-WATERPROOFING APPLICATION

- A. Install self-adhering sheets according to waterproofing manufacturer's written instructions and recommendations in ASTM D6135.
- B. Apply primer to substrates at required rate and allow to dry. Limit priming to areas that will be covered by sheet waterproofing in same day. Reprime areas exposed for more than 24 hours.
- C. Apply and firmly adhere sheets over area to receive waterproofing. Accurately align sheets and maintain uniform 2-1/2-inch minimum lap widths and end laps. Overlap and seal seams and stagger end laps to ensure watertight installation.
 1. When ambient and substrate temperatures range between 25 and 40 deg F, install self-adhering, rubberized-asphalt sheets produced for low-temperature application. Do not use low-temperature sheets if ambient or substrate temperature is higher than 60 deg F.
- D. Apply continuous sheets over sheet strips bridging substrate cracks, construction, and contraction joints.
- E. Seal exposed edges of sheets at terminations not concealed by metal counterflashings or ending in reglets with mastic or sealant.
- F. Termination Bars: Securely fasten top termination of membrane with continuous metal termination bar anchored into substrate and cover with detailing tape.
 1. Install termination bar 2" below finish grade, coordinate with precast exterior finish transition locations.
 2. Apply compatible sealant at top edge of termination bar. Refer to section 079000 - Joint Protection.
- G. Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Slit and flatten fishmouths and blisters. Patch with sheets extending 6 inches beyond repaired areas in all directions.
- H. Correct deficiencies in or remove sheet waterproofing that does not comply with requirements, repair substrates, reapply waterproofing, and repair sheet flashings.

3.4 INSULATION INSTALLATION

- A. Foundation Wall Insulation: Install insulation over drainage panels in compliance with Section 072100 - Thermal Insulation.

3.5 PROTECTION AND CLEANING

- A. Do not permit foot or vehicular traffic on unprotected membrane.
- B. Protect waterproofing from damage and wear during remainder of construction period.
- C. Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.
- D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 071413

HOT-FLUID APPLIED RUBBERIZED ASPHALT WATERPROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Hot applied fabric-reinforced rubberized asphalt waterproofing system (WP-1) on vertical, horizontal and sloped concrete surfaces with the following systems applications.
 - 2. Garden roof (extensive).
- B. Related Sections:
 - 1. Section 033000 - Cast-in-Place Concrete: Concrete cover.
 - 2. Section 072100 - Building Insulation: Rigid insulation cover.
 - 3. Section 076210 - Prefinished Flashing and Sheet Metal: Metal flashing.
 - 4. Section 079000 - Joint Protection.

1.2 SYSTEM DESCRIPTION

- A. Horizontal Waterproofing System - Fabric Reinforced System (WP-1): 215 mil thick hot applied rubberized asphalt system consists of the following:
 - 1. Galvanized steel angles set in grid pattern, cast into structural slab.
 - 2. Surface conditioner and neoprene flashing.
 - 3. 215 mil membrane: Composite application consisting of 90 base layer of asphalt, embedded layer of polyester fabric, and 125 mil top layer of asphalt.
 - 4. Protection sheet embedded in top surface.
 - 5. Drainage board.
 - 6. Insulation Type INSUL-5, high density.
 - 7. Filter fabric layer over top of insulation

1.3 SUBMITTALS

- A. Comply with Section 013300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including following.
 - 1. Detailed specification of construction and fabrication.
 - 2. Manufacturer's installation instructions, specifically written for this project including procedures and materials for flashing, splicing and bonding.
- C. Shop Drawings: Indicate specific modifications of manufacturer's standard details to comply with project requirements plus the following specific requirements.
 - 1. Indicate layout of sheets, location of field splices, type of splices, and termination details.
- D. Quality Control Submittals: Comply with Section 014500.
 - 1. Statement of qualifications for manufacturers and installers.
 - 2. Statement of compliance with CGSB 37.50-M89.
- E. Contract Closeout Submittals: Comply with Section 017700.
 - 1. Special warranties.
 - 2. Manufacturer's field reports.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Firm specializing in installation of types of waterproofing required for project for not less than 3 years and is acceptable to waterproofing manufacturer.
- B. As applicable, assign work closely associated with waterproofing, including (but not limited to) waterproofing accessories, flashings in connection with waterproofing, expansion joints in membrane, insulation and protection course on membrane, to installer of waterproofing, for undivided responsibility.

- C. Pre-installation Conference: Membrane waterproofing applicator, manufacturer's representative, Contractor and Architect shall meet at Site to review membrane waterproofing procedure, acceptance of substrate surfaces, and coordination with other trades.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original containers with seals unbroken, labeled with manufacturer's name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
- B. Store materials in their original undamaged containers in clean, dry, protected location and within temperature range required by waterproofing manufacturer. Protect stored materials from direct sunlight.
- C. Remove and replace material that cannot be applied within its stated shelf life.

1.6 PROJECT CONDITIONS

- A. Substrate: Proceed with work of this section only after substrate construction and penetrating work have been completed.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply waterproofing membrane during inclement weather or when air temperature is below 40 degrees F.
- B. Do not apply waterproofing membrane to damp, frozen, dirty, dusty, or unsuitable surfaces. Concrete surfaces shall be cured for 28 days unless otherwise allowed by manufacturer.
- C. Provide positive exhaust ventilation when waterproofing membrane is applied in enclosed areas, to remove toxic fumes.
- D. At existing occupied buildings and at additions to existing occupied buildings, provide material with VOC (Volatile Organic Content) of 0.

1.8 WARRANTY

- A. Contractor/manufacturer/installer shall warrant installed system for period of 5 years from Date of Substantial Completion against all the conditions indicated below. When notified in writing from Owner, Contractor/manufacturer/installer shall promptly, and without inconvenience and cost to Owner, correct said deficiencies.
 - 1. Water-tight condition covered by Contractor/installer.
 - 2. Faulty workmanship covered by Contractor/installer.
 - 3. Defective material covered by manufacturer.
 - 4. Correction includes responsibility for removal and reinstallation of other Work which conceals membrane waterproofing.
 - 5. During special warranty period, repairs and replacements required because acts of God and other events beyond manufacturer's/installer's control shall be completed by manufacturer/installer and will be paid for by Owner at prevailing rates.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Waterproofing Membrane (WP-1): Hot applied rubberized asphalt, cake form for field melting.
 - 1. Comply with CGSB 37.50-M89.
 - 2. Resistant to acids that will be encountered in fertilizers, building washes, and acid rain.
 - 3. Fillers: Inert clay and not calcium carbonate.
- B. Surface Conditioner: Cut-back asphalt conforming to ASTM D41 and specially modified as recommended by membrane manufacturer.
- C. Reinforcing Sheet and Expansion Joint Flashing: 60 mil uncured neoprene.

- D. Polyester Fabric Flashing: 0.09 pound spun-bonded polyester.
- E. Neoprene Flashing: 45 mil uncured neoprene.

2.2 ACCESSORIES

- A. Large Diameter Backing Material: Pipe insulation.
- B. Drainage Board: High density polyethylene drainage core bonded to a calendared non-woven geotextile.
- C. Rigid Insulation (Directly Related to Waterproofing): Provide under this Section to comply with requirements specified under Section 072100.
- D. Filter Fabric: 2.5 ounce, 100 percent polyester fiber with acrylic binder.
- E. Stainless Steel Cap Flashing: 0.20 stainless steel, 4 inch high surface mounted complete with non-corrosive fasteners; prefabricated internal and external corners.
- F. Sealant for Stainless Steel Cap Flashing (Directly Related to Waterproofing): Provide Sealant Type SLNT-1 under this Section to comply with requirements specified under Section 079000.
- G. Filter Fabric: Provide under this Section.
- H. Roof Deck Insulation: Refer to Section 072100.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Ensure substrate is clean and free of depressions, waves or projections and is properly sloped to drainage locations.
 - a. Finish texture of concrete substrate: Wood float finish.
 - 2. Ensure curbs, pipes, sleeves, ducts, and vents through substrate are solidly set.
 - 3. Ensure cant strips, reglets and nailing strips are properly located and installed.
 - 4. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Form slight cove at vertical surfaces and fill cracks and joints with mastic or sealer in conformance with manufacturer's instructions.
- B. Clean surfaces of foreign matter detrimental to installation of membrane. Sand areas to remove curing membrane if resin or other non-compatible type curing material was used.
 - 1. Coordinate requirements with Work of Section 033000.
- C. Moisture Content: Check moisture content of substrate to ensure current moisture content is within membrane manufacturer's requirements. Provide additional drying techniques or equipment to obtain compliance.
- D. Apply surface conditioner at a rate recommended by manufacturer and allow to dry.

3.3 MEMBRANE INSTALLATION

- A. Comply with manufacturer's recommendations.
- B. Melt asphalt cakes to comply with manufacturer's recommendations to uniform temperature of 400 Degrees F (50 Degrees +/- maximum).
- C. Apply hot asphalt over substrate at average coating of 90 mils (3/32 inch) thickness, then embed layer of reinforcing fabric, followed by another coat of membrane at minimum 125 mils. Total minimum thickness of 215 mils.

1. Overlay process: While membrane is still warm and tacky, cover entire surface of membrane, including work at joints and cracks, with 60 mil uncured neoprene sheet, lapping seams 6 inches and sealing laps and joints hot asphalt.
 2. Ensure neoprene overlay is free of bulges, fish-mouths or bubbles. Cut-out defective areas, patch, and recoat with hot asphalt while system is still warm.
- D. Construction Joints: At construction joints and cracks over 1/16 inch and less than 1/4 inch wide, embed 6 inch wide strip of polyester fabric flashing into hot asphalt along the joint.
1. Allow assembly to cool and apply second 1/8 inch of hot asphalt.
 2. Extend second coat not less than 3 inches beyond each side of flashing.
- E. Exterior Vertical Corners: Embed 6 inch wide strip of 60 mil uncured neoprene flashing into hot asphalt.
1. Allow assembly to cool and apply second coat of hot asphalt.
 2. Extend second coat not less than 3 inches beyond each side of flashing.
- F. Interior Vertical Corner: Similar to external, but use polyester fabric flashing.
- G. Expansion Joints: At expansion joints and cracks over 1/4 inch, install 12 inch wide strip of 60 mil uncured neoprene flashing with looped down configuration or roll over large diameter backing material to allow free movement.
1. Embed edges of flashing in hot asphalt.
 2. Allow assembly to cool and apply second 1/8 inch coat of hot asphalt.
 3. Extend second coat not less than 6 inches beyond each side of flashing.
- H. Flashings: At joints and transitions between horizontal and vertical surfaces, and at penetrations and drains, reinforce with 60 mil uncured neoprene to comply with expansion joint detailing specified above.
1. Corner reinforcement at concealed location of identical substrate: Use polyester fabric.

3.4 ACCESSORY INSTALLATION

- A. After water tests, specified under Field Quality Control below, are completed, install drainage board over membrane and protection board.
- B. Install drainage board as indicated.
- C. Cap Flashing: Over membrane along foundation wall at finish grade, install cap flashing to cover top edges of waterproofing that extends above grade. Anchor cap flashing securely in place to comply with the manufacturer's directions. Butt joints tightly and set in bed of sealant.
 1. Close and seal ends to maintain weather-tightness and fill top trough with sealant to provide weather-tight, surface-mounted cap flashing.

3.5 FIELD QUALITY CONTROL

- A. Water Tests at Horizontal Surfaces: On completion of installation of membrane, dam areas in preparation for flood testing. If entire area is too large to test at one time, divide into smaller pieces.
 1. Flood area to a depth of not less than 3 inches with clean water. After not less than 24 hours, check for leaks.
 2. If leaking is found, patch using same waterproofing materials; repeat flood test.
 3. When the area is proved watertight, drain the water and remove dam.
- B. Water Test at Vertical Surfaces: Owner's testing laboratory shall visually inspect entire vertical wall prior to placement of drainage board and backfill, and shall issue written statement accepting surface.
 1. If defects or areas of minimum coverages are found by testing laboratory, patch using waterproofing and reinforcing sheets as necessary.
- C. Manufacturer's Field Services: Membrane manufacturer's technical representative shall provide following field services during installation.
 1. Pre-form a pre-installation examination and acceptance of substrate and surface preparation for each stage. Issue report.

2. Be present at initial start-up for each process. Confirm application rates and techniques. Issue report.
3. Issue summary report at completion of installation indicating manufacturer's acceptance of installed system and warranty conditions.

3.6 PROTECTION

- A. Institute procedures for protection of completed membrane during installation of work over membrane and throughout remainder of construction period. Do not allow traffic of any type on unprotected membrane.
- B. Temporary Protection: Provide temporary protection if there are delays in Work or sequencing such that materials will not be properly protected. Remove temporary protection when Work is resumed.

END OF SECTION

SECTION 072100 THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Foundation wall insulation.
 - 2. Cavity wall insulation.
 - 3. Concealed building insulation.
- B. Related Sections:
 - 1. Section 072670 - Moisture Barriers.
 - 2. Section 072400 - Exterior Insulation and Finish System (EIFS).
 - 3. Section 074215 - Aluminum Formed Panels: Insulation in connection with metal panels.
 - 4. Section 075400 - Thermoplastic Membrane Roofing: Roof insulation.
 - 5. Section 076100 - Sheet Metal Roofing.
 - 6. Section 084400 - Aluminum Curtain Walls, Windows and Entrances: Curtain wall insulation.
 - 7. Section 092900 - Gypsum Board: Acoustical insulation.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Source Limitations: Obtain each type of building insulation through one source.
- B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.
 - 1. Surface-Burning Characteristics: ASTM E84.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.
- B. Protect plastic insulation as follows:
 - 1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
 - 2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
 - 3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. (INSUL-1) Rigid Insulation: ASTM C578; Type IV, 25 psi compressive strength, extruded cellular polystyrene type; for below grade application:
- B. (INSUL-5) High-Density Rigid Insulation: ASTM C578; 60 psi compressive strength per ASTM D 1621, installed in one layer.
 - 1. Drainage Channel: One side when used over horizontal waterproofing or where indicated.

- C. (INSUL-15) Polyisocyanurate Rigid Insulation: ASTM C1289, Type I, Class II; glass fiber reinforced polyisocyanurate insulation with aluminum foil facing on both faces; for cavity wall application.
 - 1. Water Vapor Transmission as Permeance: Less than 0.03 in accordance with ASTM E96.
 - 2. Compressive Strength: 25 psi.
 - 3. Flame Spread Rating, ASTM E84: Not to exceed 25.
 - 4. R Value: 6.5 per inch thickness in accordance with ASTM C518 (aged 190 day at 140 degrees)
 - 5. Thickness: Maximum 4 inches in single layer.

2.2 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated securely in position indicated with self-locking washer in place; and complying with the following requirements:
 - 1. Plate: Perforated galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 - 2. Spindle: Copper-coated, low carbon steel, fully annealed, 0.105 inch (2.67 mm) in diameter, length to suit depth of insulation indicated.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick galvanized-steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
- C. Insulation Standoff: Spacer fabricated from galvanized mild-steel sheet for fitting over spindle of insulation anchor to maintain air space of dimension indicated between face of insulation and substrate to which anchor is attached.
- D. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.
- B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice and snow.
- C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.
- D. Water-Piping Coordination: If water piping is located on inside of insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.
- E. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.
- F. Refer to Section 072600 - Vapor Retarders for installation of vapor retarder. Coordinate with 072600 for installation of insulation to insure protection of insulation and retarder.

3.2 INSTALLATION QUALITY

- A. Install rigid insulation to maintain continuous and complete thermal protection for building spaces and elements.
- B. Ensure surfaces which are to receive rigid insulation are clean, free of deleterious matter and are sufficiently level to allow proper installation of insulation.
- C. Cut and trim insulation neatly to fit spaces. Butt edges and ends tight. Fit insulation tight against mechanical, electrical and other items which protrude through plane of insulation.
- D. Use insulation free of broken or chipped edges.

3.3 PREPARATION

- A. Clean substrates and substances harmful to insulation or vapor retarders, including removing projections capable of puncturing retarders or interfering with insulation attachment.

3.4 PERIMETER FOUNDATION WALL INSTALLATION

- A. Secure insulation (INSUL-1) on perimeter foundation wall with adhesive using spot or bead method in accordance with insulation manufacturer's recommendations. Place insulation horizontally.
 - 1. Coordinate installation with waterproofing systems where applicable.
- B. Stagger vertical joints of insulation, except free ends over line of control joints.
- C. Lay out insulation so that ends overlap minimum 4 inches and maximum 6 inches over line of expansion contraction joints. Leave overlapping ends of insulation unbonded over line of these joints, allowing insulation to move freely with foundation walls.

3.5 CAVITY WALL INSTALLATION ON STEEL STUD BACKUP

- A. Secure insulation (INSUL-15) within cavity walls in place over sheathing.
 - 1. Secure insulation with mechanical fasteners compatible with insulation and substrate. Coordinate compatibility with moisture barrier Section.
 - 2. Continuously tape perimeter edges and joints of insulation boards at back-up surfaces to maintain vapor retarder continuity.
 - 3. Place insulation horizontally.
 - 4. Press insulation firmly and uniformly against wall sheathing.
 - 5. Fit joints tightly together.
 - 6. Fill joints, including to adjacent materials, and brick ties or stone anchors protruding through insulation with silicone sealant.
- B. Stagger vertical joints of insulation, except free ends over line of control joints.
- C. Leave insulation unbonded over line of control joints.
- D. Repair damaged foil surfaces of insulation with foil tape.

3.6 PROTECTION

- A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes.
- B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.
- C. Repair vapor retarders as recommended by manufacturer.

END OF SECTION

SECTION 072400 EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Adhesively attached exterior insulation and finish system with weather resistive barrier
- B. Related Sections:
 - 1. Section 072100 - Building Insulation: Other rigid insulation.
 - 2. Section 072670 - Moisture Barrier.
 - 3. Section 079000 - Joint Protection.

1.2 DEFINITIONS

- A. Backwrapping: Continuation of base coat and fiberglass reinforcing fabric around the edge of insulation board and onto the substrate in back of the insulation.
- B. Edgewrapping: Continuation of base coated fiberglass reinforcing fabric around the edge of the insulation board and onto the rough opening wall framing or masonry.
- C. Expansion Joint: Sealant, back-up material and primer manufactured by others, forming a moveable juncture between adjacent materials.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

- A. Bond Integrity: Free from bond failure within system components or between system and supporting wall construction, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
- B. Weathertightness: Resistant to water penetration from exterior into system and assemblies behind it or through them into interior of building that results in deterioration of thermal-insulating effectiveness or other degradation of system and assemblies behind system including substrates, supporting wall construction, and interior finish.
- C. Class PB EIFS: Provide EIFS having physical properties and structural performance that comply with the following when tested per methods referenced:
 - 1. Abrasion Resistance: Sample consisting of 1-inch- thick EIFS mounted on 1/2-inch- thick gypsum board; cured for a minimum of 28 days; and showing no cracking, checking, or loss of film integrity after exposure to 528 quarts of sand when tested per ASTM D 968, Method A.
 - 2. Accelerated Weathering Characteristics: Sample of size suitable for test equipment and consisting of 1-inch- thick EIFS mounted on 1/2-inch- thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 2000 hours when viewed under 5 times magnification per ASTM G 23, Method 1, or ASTM G 53.
 - 3. Absorption-Freeze Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
 - 4. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch (50.8-by-50.8-mm) clean glass substrate, cured for 28 days, and showing no growth when tested per ASTM D 3273.
 - 5. Salt-Spray Resistance: Sample consisting of 1-inch- (25.4-mm-) thick EIFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 300 hours per ASTM B 117.
 - 6. Tensile Adhesion: No failure in the adhesive, base coat, or finish coat. Minimum 5-psi (34.5-kPa) tensile strength before and after freeze-thaw and accelerated weathering tests per EIMA 101.03.

7. Water Penetration: Sample consisting of 1-inch- (25.4-mm-) thick EIFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board, cured for 28 days, and showing no water penetration into the plane of the base coat to expanded polystyrene board interface of the test specimen after 15 minutes at 6.24 lbf/sq. ft. (299 Pa) of air pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per EIMA 101.02.
 8. Water Resistance: Sample consisting of 1-inch- (25.4-mm-) thick EIFS mounted on 1/2-inch- (12.7-mm-) thick gypsum board; cured for 28 days; and showing no cracking, checking, crazing, erosion, rusting, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
 9. Impact Resistance: Sample consisting of 1-inch- (25.4-mm-) thick EIFS when constructed, conditioned, and tested per EIMA 101.86; and meeting or exceeding the following impact classification and range:
 - a. Medium Impact Resistance: 50 to 89 inch-lb (5.7 to 10.1 J).
 10. Positive and Negative Wind-Load Performance: Sample assembly, 48 by 48 inches (1220 by 1220 mm) in size, consisting of studs, sheathing, and 1-inch- (25.4-mm-) thick EIFS; and showing capability to withstand wind loads indicated when tested per ASTM E 330.
 11. Drainage: 3 samples capable of draining water, and having an average minimum true drainage efficiency of 75 percent when tested per EIMA 200.2.
- D. Water-/Weather-Resistive-Barrier Coating: With physical properties that comply with the following when tested on substrate per methods referenced:
1. Tensile Adhesion: No failure in bond when 5 samples of water-/weather-resistive coating are applied to substrate and tested at a minimum 15-psi flatwise tensile strength per ASTM C 297.
 2. Absorption-Freezing Resistance: No visible deleterious effects and negligible weight loss after 60 cycles per EIMA 101.01.
 3. Water Penetration: 3 samples each sized not less than 4 by 8 feet; consisting of coating applied to substrate including a minimum of 2 vertical joints and 1 horizontal joint within sheathing substrate, each joint not less than 0.125 inch wide; and tested sequentially as follows:
 - a. Passing 10 cycles at 80 percent positive design load (design load is defined as ultimate load with a safety factor of 3.0 imposed) as the maximum test load when tested in accordance with ASTM E 1233, Procedure A.
 - b. No water penetration on the plane of the exterior-facing side of substrate after 75 minutes at 6.24 lbf/sq. ft. of air-pressure difference or 20 percent of positive design wind pressure, whichever is greater, across the specimen during a test period when tested per ASTM E 331.
 4. Water Resistance: 3 samples, each sized not less than 4 by 6 inches and consisting of coating applied to substrate, showing no cracking, checking, crazing, erosion, blistering, peeling, or delamination after testing for 14 days per ASTM D 2247.
 5. Water Vapor Transmission: Three samples prepared by applying the coating, at recommended thickness, to a nonadhesive surface and removing cured coating film. Average thickness is determined from material density, area, and weight and samples are tested per ASTM E 96 after conditioning at 75 plus or minus 5 deg F (24 plus or minus 3 deg C) and 50 percent relative humidity for 40 hours before testing.

1.4 SYSTEM DESCRIPTION

- A. (EIFS) Adhesively attached exterior insulation and finish system:
1. Water/Weather Resistive Barrier over approved gypsum sheathing
 2. Expanded insulation board (EPS), adhesively attached over Water/Weather Resistive Barrier.
 3. Base coat (2-coats) with imbedded standard glass-fiber-mesh on insulation
 4. Primer
 5. Finish coat

1.5 SUBMITTALS

- A. Product Data: For each type and component.

- B. Shop Drawings: For EIFS. Project specific shop drawings, including plans, elevations, sections, details of components, details of penetration and termination, flashing details, joint locations and configurations, fastening and anchorage details including mechanical fasteners, and connections and attachments to other work.
- C. Samples for Verification: 24-inch- square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work, a typical control joint filled with sealant of color selected.
 - 1. Include sealants Samples to verify color selected.
- D. Warranty: Submit 2 copies of manufacturer's warranty for exterior insulation and finish system.
- E. Compatibility and Adhesion Test Reports: For joint sealants from sealant manufacturer indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation needed for adhesion.
- F. Maintenance Data: For EIFS to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Manufacturer: Member of Exterior Insulation Manufacturers Association.
- B. Installer Qualifications: An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer's system using trained workers
- C. Source Limitations: Obtain EIFS through one source from a single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with system components.
- D. Fire-Test-Response Characteristics: Provide EIFS and system components with the following fire-test-response characteristics as determined by testing identical EIFS and system components per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting agency.
 - 1. Fire-Resistance Characteristics: Provide materials and construction tested for fire resistance per ASTM E 119.
 - 2. Full-Scale, Multistory Fire Test: Tested mockup, representative of completed multistory wall assembly of which EIFS is a part, complies with local code standards for test method and required fire-test-response characteristics of exterior non-load-bearing wall panel assemblies containing foam-plastic insulation.
- E. Surface-Burning Characteristics: Provide insulation board, adhesives, base coats, and finish coats with flame-spread index of 25 or less and smoke-developed index of 450 or less, per ASTM E 84.
- F. Field-Constructed Mock-Up: Prior to installation of system, erect mock-ups for each form of wall construction and finish required to verify selections made under sample submittals and to demonstrate esthetic effects including those related to execution. Build mock-ups to comply with following requirements, using materials indicated for final work:
 - 1. Locate mock-ups on site in location and of size indicated or, if not indicated, as directed by Architect.
 - 2. Demonstrate proposed range of color, texture, and workmanship to be expected in completed work.
 - 3. Obtain Architect's acceptance of mock-ups before start of final work.
 - 4. Retain and maintain mock-ups during construction for judging completed work.
- G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials in unopened, undamaged containers, clearly marked and identified with manufacturer's name and description of contents.

- B. Store products in cool, dry place out of direct sunlight, protected from weather and other damage. Stack insulation board flat and off ground.

1.8 PROJECT CONDITIONS

- A. Weather Limitations: Maintain ambient temperatures above 40 deg F for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.
- B. Protection: Protect system and adjacent surfaces during installation and when unattended and when curing, from weather and other damage.

1.9 COORDINATION

- A. Sequence installation of system with related work specified in other sections to ensure that wall assemblies, including flashing, moisture barrier, trim, and joint sealers, are protected against damage from weather, aging, corrosion, or other causes.

1.10 WARRANTY

- A. Completed exterior insulation and finish system installation shall be warranted by manufacturer, in accordance with manufacturer's standard warranty, for period of 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Compatibility: Provide substrates, water-/weather-resistive barriers, adhesive, fasteners, board insulation, reinforcing meshes, base- and finish-coat systems, sealants, and accessories that are compatible with one another and approved for use by EIFS manufacturer for Project.

2.2 MATERIALS FOR EIFS

1. Water/Weather Resistive Barrier Coating: EIFS manufacturer's standard waterproof mixture complying with the following requirements for material composition and method of combining materials:
 - a. Job-combined formulation of manufacturer's standard polymer-emulsion adhesive and manufacturer's standard dry mix containing portland cement.
2. Adhesive for Application of Insulation: EIFS manufacturer's standard formulation designed for indicated use, compatible with substrate, and complying with the following requirements:
 - a. Factory-blended dry formulation of portland cement, dry polymer admixture, and fillers specified for base coat.
3. Insulation: Expanded polystyrene insulation board ASTM C578, Type I and complying with EIFS manufacturer requirements.
 - a. Size: 2 feet by 4 feet.
 - b. Insulation shall meet code requirement of IBC, 2603.5.6 Label required: The edge or face of each piece of foam plastic insulation shall bear the label of an approved agency. The label shall contain the manufacturer's or distributor's identification, model number, serial number or definitive information describing the product or materials' performance characteristics and approved agency's identification.
4. Base Coat: Factory-blended dry formulation of portland cement, dry polymer admixture, and inert fillers to which only water is added at Project site.
5. Reinforcing Mesh: Balanced, alkali-resistant, open-weave glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multi-end strands with retained mesh tensile strength of not less than 120 lbf/in. per EIMA 105.01, complying with ASTM D 578 and the following requirements for minimum weight:
 - a. Standard-Impact Reinforcing Mesh: Not less than 4.0 oz./sq. yd.
 - b. Strip Reinforcing Mesh: Not less than 3.75 oz./sq. yd. .
 - c. Detail Reinforcing Mesh: Not less than 4.0 oz./sq. yd.

- d. Corner Reinforcing Mesh: Not less than 7.2 oz./sq. yd.
- 6. Primer: As recommended by finish coat manufacturer.
- 7. Finish Coat: EIFS manufacturer's DPR (dirt pick-up resistant) acrylic-based coating with mildew resistance complying with the following requirements for material composition and method of combining materials:
 - a. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, mildew additive, and fillers.
 - 1) Colors and textures to be selected by Architect from manufacture's standards.

2.3 ACCESSORIES

- A. Flexible-Membrane Flashing: Cold-applied, fully self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.
- B. Termination Edge Drainage Material: Designed to provide drainage, EIFS manufacturer's standard or product recommended.
- C. Other products: As recommended by EIFS manufacture for their systems.

2.4 MIXING

- A. Comply with system manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as approved by system manufacturer. Mix materials in clean containers. Use materials within time period specified by system manufacturer or discard.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of EIFS.
- B. Examine roof edges, wall framing, moisture barrier, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected

3.2 PREPARATION

- A. Protect contiguous work from moisture deterioration and soiling resulting from application of systems. Provide temporary covering and other protection needed to prevent spattering of exterior finish coatings on other work.
- B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.

3.3 INSTALLATION - GENERAL

- A. General: Comply with ASTM C 1397 and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.
- B. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, base of wall, and at window heads and sills, and elsewhere as indicated, according to EIFS manufacturer's written instructions. Coordinate with installation of insulation.
 - 1. Window Heads, Sill Flashing, and Base of Wall Flashing: Sheetmetal flashing furnished by Division 7 "Sheet Metal Flashing".
- C. Expansion Joints: Install at locations indicated, where required by EIFS manufacturer, and as follows:
 - 1. Where expansion joints are indicated in substrates behind EIFS.
 - 2. Where EIFS adjoin dissimilar substrates, materials, and construction.

3. Where wall height changes.

3.4 INSTALLATION OF EIFS

- A. Primer/Sealer: Apply over gypsum sheathing substrates to protect substrates from degradation and where required by EIFS manufacturer for improving adhesion of insulation to substrate.
- B. Water-/Weather-Resistive-Barrier Coating: Apply over substrates to protect substrates from degradation.
 1. Seal joints, exposed edges, terminations, and inside and outside corners of sheathing with manufacturer's accessory tape and coatings, unless otherwise indicated by EIFS manufacturer's written instructions.
- C. Flexible-Membrane Flashing: Install over weather-resistive barrier, applied and lapped to shed water; seal at openings, penetrations, terminations, and where indicated by EIFS manufacturer's written instructions to protect wall assembly from degradation. Prime substrates, if required, and install flashing to comply with EIFS manufacturer's written instructions and details.
- D. Board Insulation: Adhesively attach insulation to substrate in compliance with ASTM C 1397, EIFS manufacturer's written requirements, and the following:
 1. Apply adhesive to insulation by notched-trowel method with ribbons running vertically. Apply adhesive to a thickness of not less than 1/4 inch for factory mixed measured from surface of insulation before placement.
 2. Press insulation into place. Apply pressure over the entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
 3. Allow adhered insulation to remain undisturbed for period recommended by EIFS manufacturer, but not less than 24 hours, before beginning rasping and sanding insulation, or applying base coat and reinforcing mesh.
 4. Begin first course of insulation from a level base line for base flashing and work upward. Work from perimeter joints toward interior of panels if possible.
 5. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than 12 inches wide or 6 inches high. Offset joints not less than 6 inches from corners of window and door openings and not less than 4 inches from aesthetic reveals.
 6. Interlock ends at internal and external corners.
 7. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than 1/16 inch occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
 8. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
 9. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/16 inch from surface of insulation and to remove yellowed areas due to sun exposure; do not create depressions deeper than 1/16 inch.
 10. Cut aesthetic reveals in outside face of insulation with high-speed router, hot wire cutter or knife configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than 3/4 inch.
 11. Interrupt insulation for expansion joints where indicated.
 - a. Install expansion joints at locations indicated and as follows:
 - 1) Where expansion or control joints occur in surface of construction directly behind insulation.
 - 2) Where system abuts dissimilar materials.
 - 3) Changes in roof line.
 - 4) Changes in building shape and/ or structural system.
 - 5) Where substrate changes.
 12. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.

- a. Install expansion joints at locations indicated or, if not indicated, at locations complying with following criteria and as directed by Architect:
 - 1) Where distance between control joints exceeds 50 feet in any direction.
 - 2) Where panels formed by system change in size. Extend joints full width or height of protective coating.
 - 3) Above and below door and window openings
 - b. Size:
 - 1) 1/2" where EIFS abuts other materials.
 - 2) 3/4" when EIFS abuts the EIFS.
- 13. After installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than 2-1/2 inches over front and back face, unless otherwise indicated on Drawings.
 - a. Contractor's Option: Use pre back wrapped panels available from manufacturer at base of wall and at window and door heads.
- 14. Treat exposed edges of insulation as follows:
 - a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
 - b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
- 15. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and EIFS protective coating lamina.
- E. Base Coat: Apply 1st coat to exposed surfaces of insulation in minimum thickness recommended in writing by EIFS manufacturer..
- F. Reinforcing Mesh: Embed type indicated below in wet base coat to produce wrinkle-free installation with mesh continuous at corners and overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written requirements edges. Overlap reinforcing mesh within 8 inches of corners. Apply 2nd base coat to embed mesh, so reinforcing-mesh color and pattern are not visible.
 - 1. Use standard reinforcing mesh throughout.
- G. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings extending 4 inches beyond perimeter. Apply additional 9-by-12-inch strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch- wide strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches on each side of corners.
 - 1. At aesthetic reveals, apply strip reinforcing mesh not less than 8 inches wide.
 - 2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.
- H. Primer: Apply over dry base coat according to EIFS manufacturer's written instructions.
- I. Finish Coat: Apply over dry primer, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

3.5 INSTALLATION OF JOINT SEALANTS

- A. Prepare joints for sealant, of type and at locations indicated, to comply with applicable requirements in Division 7 Section "Joint Sealers" and in EIMA's "EIMA Guide for Use of Sealants with Exterior Insulation and Finish Systems, Class PB."
 - 1. Installation of sealant by Division 7 Section "Joint Protection"

3.6 CLEANING AND PROTECTION

- A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive system coatings.

- B. Provide final protection and maintain conditions in manner acceptable to Installer and system manufacturer that ensures systems being without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 072600 VAPOR RETARDERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Wall vapor retarders

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Manufacturer's installation instructions for placement, seaming and pipe boot installation

1.3 QUALITY ASSURANCE

- A. Applicator: Company specializing in retarder type work with minimum 3 years experience in application of retarder.

PART 2 PRODUCTS

2.1 VAPOR RETARDERS

- A. (VR) Polyethylene Vapor Retarder: ASTM D 4397, 6 mils thick, with maximum permeance rating of 0.13 perm.

2.2 AUXILIARY MATERIALS

- A. Seam Tape at Vapor Retarders:
 - 1. Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.
 - 2. Minimum: 2 inches wide.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Verify that sleeves, ties, and other penetrating components which pass through surfaces to receive retarder are rigidly installed.

3.2 PREPARATION

- A. Clean substrates of substances harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.3 INSTALLATION FOR VAPOR RETARDERS

- A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated.
 - 1. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

- B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.
- C. Firmly attach vapor retarders to substrates with mechanical fasteners or adhesives as recommended by vapor-retarder manufacturer.
- D. Seal end laps and terminations after each day's work with trowelled bead of mastic. Lap sides 2-1/2 inches minimum and ends 6 inches.
- E. Seal ends and edges to each other and to adjoining surfaces with uniform fillet bead of sealant. Extend vapor retarder to perimeter of windows and door frames and other items interrupting plane of membrane.
 - 1. Imbed vapor retarder in sealant and tape edge to window or door frame.
- F. Apply heavy pressure to membrane at top and bottom terminations with back of utility knife to assure positive adhesion at edge.
 - 1. Roll membrane firmly and completely, immediately after each sheet is applied.
- G. Lap joints on sloped substrate in direction of drainage.
- H. Work out air bubbles, wrinkles, and fishmouths. Firmly press sheet into place without stretching.
- I. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
- J. Metal deck at wall, cut vapor retarder to fit flutes of decking and imbed vapor retarder in sealant and tape edge to metal deck.
- K. After installation protect membrane from damage.
- L. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

END OF SECTION

SECTION 072670 MOISTURE BARRIER

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes
 - 1. Spray applied moisture barrier system
- B. Related Sections
 - 1. Section 033000 - Cast-In-Place Concrete.
 - 2. Division 5 - Metal - Structural.
 - 3. Section 072100 - Thermal Insulation.
 - 4. Section 075400 – Thermoplastic Membrane Roofing.

1.2 SYSTEM DESCRIPTION

- A. (MB) Moisture Barrier: One or two-part, self-curing, rubber based liquid applied barrier, 1.5mm (60 mils) thick, complete with pre-treatment, scratch coats and sealers, cleaners and required accessories.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's instructions for surface conditioner compatibility, primer, mastic, membrane, temperature range for application of barrier materials.
- B. Compatibility: Verify compatibility of barrier materials with adjacent materials.

1.4 QUALITY ASSURANCE

- A. Liquid Applied Membrane Applicator: Company specializing in liquid moisture and vapor barrier type work with minimum 3 years experience in application of liquid type moisture barrier.
- B. Pre-Installation Conference:
 - 1. Prior to installation of barrier, conduct pre-installation conference at project site.
 - 2. Attendance: Contractor, job superintendent, subcontractors, supplier and manufacturer's technical representative.
 - 3. Agenda: Cover installation and coordination procedures, protective measures and related conditions.

1.5 PROJECT CONDITIONS

- A. Do not apply barrier during inclement weather or when air temperature is below 40 degrees F., unless manufacturer's written application instructions indicate otherwise.
- B. Do not apply barrier to damp, frozen, dirty, dusty, or surfaces unacceptable to manufacturer.

1.6 WARRANTY

- A. Manufacturer and installer of moisture barrier shall provide a warranty which shall provide for making good, within period of 3 years, at no cost to Owner, failures of barrier to resist penetration of water, except where such failures are:
 - 1. Result of structural failures of building.
 - 2. Cracking of membrane due to temperature or shrinkage is not considered as structural failure.
- B. Manufacturer and installer of moisture barrier shall repair and make good barrier membrane and pay for and repair or replace affected or damaged materials or surfaces at no cost to Owner.

1.7 COORDINATION

- A. Coordinate installation of moisture barrier with other systems including interface conditions at window and door openings, and to other waterproofing systems.

- B. Coordinate installation of system over moisture barrier to protect moisture barrier from UV exposure.

PART 2 PRODUCTS

2.1 FLUID-APPLIED LIQUID AIR BARRIER (ABOVE GRADE)

- A. (MB) Fluid-Applied, Vapor-Retarding Membrane Air Barrier: 1.5mm (60 dry mils) thick; one or two-part, self-curing, synthetic polymer membrane.
- B. Adhesive and Sealant: As recommended by membrane manufacturer.
- C. Material properties:
 - 1. Elongation per ASTM D413 (C) 500 percent minimum
 - 2. Working Temperature range: Minimum 20 to 180 deg. F

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that sleeves, ties, and other penetrating components that pass through surfaces to receive barrier are rigidly installed.
- B. Verify that surfaces are free of cracks, depressions, waves or projections which may be detrimental to successful installation.
- C. Ensure that exterior sheathing panels are stabilized with corners and edges fastened with appropriate screws.
- D. Starting work of this Section means acceptance of substrate and site conditions.

3.2 PREPARATION

- A. Seal cracks and joints with recommended material and sealant. Clean surfaces of foreign matter detrimental to installation of retarder.
- B. Apply surface conditioner (primer) at rate as recommended by manufacturer.

3.3 DETAIL WORK

- A. Transition and Through-Wall Flashing Membranes:
 - 1. Where directed by manufacturer's written instructions, apply before or after application of membrane to create a shingle effect and maintain continuity of the air barrier assembly from top to bottom of structure.
 - 2. Apply to beams, columns, joints, openings, and penetrations as indicated in detail drawings, overlapping edge seams minimum 2 inches and end laps minimum 4 inches.
 - 3. Use transition membranes to tie into opening frames, spandrel panels, floor intersections and changes in substrates.
 - 4. Apply in accordance with manufacturer's instructions, positioning, lapping, sealing and protecting as required.

3.4 APPLICATION OF LIQUID MEMBRANE

- A. Apply liquid/spray applied membrane barrier in accordance with manufacturer's instructions.
- B. Two part product: Mix in strict accordance with manufacturer's instructions. Mixed product should have uniform color, free of white streaks.
 - 1. Install entire contents of container as soon as possible.
- C. Over rough surfaces, install manufacturer's recommended primers, sealant, and width of membrane in accordance with manufacturer's written instructions, to reinforce areas as required.
 - 1. Seal ends and edges to each other and to adjoining surfaces with uniform fillet of membrane.

D. Joint Treatment:

1. Gaps in exterior substrates less than 1/16 inch do not require detailing.
2. Detail larger joints, gaps, inside and outside corners as recommended by manufacturer with approved materials and sealants.

E. Seal and stabilize penetration openings prior to application of membrane. Patch seams, punctures or other damage with patch of moisture barrier membrane extending 6 inches in all directions from edge of damaged area. Seal edges of patch.

1. Proceed with file by hand around the protrusion and extend membrane 6 inches onto substrate and minimum of 2 inches onto penetration.
2. Seal watertight items projecting through membrane barrier.

F. As recommended by manufacturer, cover sprayed membrane with insulation, either:

1. after each day's work to protect membrane and avoid damage from other trades, or,
2. after membrane has cured; 16-24 hours, and firm and dry to touch.

3.5 PROTECTION

A. After installation, protect membrane from damage.

1. Cover membrane barrier to avoid damage. If air and vapor barrier system cannot be permanently covered within 30 days after installation, provide temporary UV protection and contact manufacturer.

END OF SECTION

SECTION 074215 ALUMINUM FORMED PANELS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Preformed aluminum plate panels.
 - 2. Aluminum flashing to match, including all exposed cap flashing.
 - 3. Anchors, brackets, reinforcements and attachments.
 - 4. Sealant at formed panels.

1.2 SYSTEM DESCRIPTION

- A. Design panels and connections to backup to withstand own weight, design loads due to pressure and suction of wind, seismic forces, erection forces and live and dead loads. Be responsible for design loads tributary to lateral and vertical and connections to structural frame in accordance with the work of registered Structural Engineer. "Connections" includes, but is not necessarily limited to following:
 - 1. Related items that are shop or field fastened to panels for purposes of placing and anchoring panels; clip angles and other members used to connect panels to structural steel or backup and shim, bolts, nuts, girts and steel angle clips at concealed connections.
- B. Component connections shall accommodate building movement. Provide adjustment to accommodate misalignment of structure without permanent damage to components, wracking of joint connection, breakage of seals or moisture penetration.

1.3 PERFORMANCE

- A. System (support) to accommodate movement of components without buckling, undue stress on fasteners, or other detrimental effects, when subject to seasonal temperature ranges.
- B. Preformed metal panel system to withstand code imposed design loads. Maximum allowable deflection of span: 1/180.
- C. Provide for "U" factor of 0.15.
- D. Drain water entering joints, condensation occurring in channels (supports), or migrating moisture occurring within system, to exterior.
- E. Air Infiltration: Provide wall panel systems with air infiltration rate of not more than 0.06 cfm per sq. ft. of fixed wall area when tested in accordance with ASTM E283 at static air pressure differential of 1.57 psf.
- F. Water Penetration: Provide panel systems with no water penetration as defined in test method when tested in accordance with ASTM E331 at inward static pressure differential of not less than 6.24 psf and not more than 12.0 psf.
- G. Not Permitted: Vibration harmonics; wind whistles; noises caused by thermal movement; thermal movement transmitted to other building elements; loosening, weakening or fracturing of attachments or components of system.

1.4 SUBMITTALS

- A. Shop Drawings and Product Data: Submit in accordance with Section 013300.
 - 1. Indicate dimensions, unusual formed metal configurations, panel layout, construction details, connections, method of anchorage, method of installation.
 - 2. Shop drawings and calculations signed and sealed by Structural Engineer registered in State of Project.
- B. Samples: Submit custom color samples for appearance acceptance in accordance with Section 013300.

- C. Submit warranty in accordance with Section 013300 and submit 2 copies of manufacturer's warranty as specified.

1.5 QUALITY ASSURANCE

- A. System Manufacturer and Installer: Company specializing in aluminum formed panel systems with minimum of 5 years experience.
- B. Verify dimensions by field measurement before panel fabrication. Design units to provide for adjustment and fitting of components during field installation. Preassemble units at shop to minimize mechanical joints, splicing and field assembly of units.

1.6 DESIGN RESPONSIBILITY

- A. Requirements shown by details are intended to establish design intent and basic dimensions of units or modules, profiles and sight lines of members and indicate general panel support details for which building has been designed. Within these limitations be responsible for design of metal panel system and to make whatever modifications of and additions to details as may be required to fulfill performance requirements. Maintain visual design concept as shown, including member sizes, profiles and alignment of components as near as possible provided they meet performance requirements.

1.7 MOCK-UPS

- A. Job Mock-Ups: Fabricate and erect at site, 2 full size panel units, size as directed by Architect, illustrating shape, joints, anchoring and attachment points, and finish in accordance with approved sample.
 - 1. Obtain Architect's acceptance of visual qualities of mock-ups before start of work. Accepted unit establishes minimum standard for work. Unit may be incorporated into work.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle system components to prevent damage to finished surfaces.
- B. Store and protect system components in accordance with manufacturer's recommendations.
- C. Provide wrapping or strippable coating to protect prefinished aluminum surfaces and other finished surfaces. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.9 WARRANTY

- A. Provide 3 year manufacturer's warranty to cover complete panel system for failure to meet specified requirements.

PART 2 - PRODUCTS

2.1 ALUMINUM PLATE PANELS

- A. Panels (MP): Factory formed aluminum plate panels finish to match framing system.
 - 1. Extruded Aluminum: ASTM B221; 6063 alloy, T5 temper.
 - 2. Accessories:
 - a. Sealants and Gaskets: Panel manufacturer's standard type suitable for use with installation of metal panel system; ultraviolet and ozone resistant for exterior applications.
 - b. Clips: Hidden clip design shall meet design requirements of total panel assembly; comply with AWS D1.1 for welding.
 - c. Bent metal trim.
 - d. Primer: FS TT-P-31; for shop application and field touch-up.
 - e. Touch-Up Primer for Galvanized Surfaces: FS TT-P-641; TT-P-645.
 - f. Touch-Up Paint: As recommended by panel manufacturer.

3. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, galvanized, in accordance with ANSI/ASTM A153 with 1.25 oz/sq ft coating; finish to match panel finish when exposed.

2.2 SHEET MATERIALS

- A. Face Sheet Stock: ASTM B209; 0.125 inch thick aluminum alloy suitable for finish.
- B. Steel Sections: ASTM A446; galvanized in accordance with ASTM A386.

2.3 FABRICATION

- A. Shop fabricate preformed prefinished formed metal and wall panels in accordance with reviewed shop drawings. Design and fabrication of panels shall comply with design criteria.
- B. Formed Metal: Aluminum sheet stock; smooth finish aluminum sheet profile as indicated.
- C. Formed Metal Panel: ASTM B209, alloy 3003 solid aluminum plate, minimum 0.125 inch thickness, size and profile as indicated, ensuring flat strong surface.
 1. Formed metal panels may be factory formed and prefinished type and shall match curtainwall. Coordinate color match between curtainwall and panels or formed metal units.
 2. Provide concealed fasteners.
 3. Select materials for surface flatness, smoothness and freedom from surface blemishes wherever exposed to view in finished unit.
 4. Exposed to view surfaces that exhibit pitting, seam markers, roller marks, "oil canning", stains, discolorations or other imperfections on finished units will not be acceptable.
- D. Column Covers and Closure Panels: Aluminum, same as above unless otherwise indicated.
- E. Panel Fasteners: Provide concealed fasteners, of stainless steel, cadmium or zinc plated. Use narrow profile fastener to achieve 1/4 inch joints throughout. No exposed fastener will be accepted.
- F. Panel System Subgirts: Aluminum of gauge, size and spacing required for panel system structural requirements, as recommended by manufacturer and in accordance with approved shop drawings. dissimilar metal separators and other accessories as required for panel system.
- G. Backer: Provide water-resistant gypsum board sheathing backer ASTM C79 with water absorption of less than 10 percent by weight after 2-hour immersion where indicated.
- H. Flashing: Aluminum, same finish as for aluminum panel where exposed; secured with concealed fastening method.
- I. Soffit Panels: Aluminum panels same as above with lapped edged filled with sealant.
- J. Condensation: Fabricate panels for control of condensation, including vapor inclusion of seals and provisions for breathing, venting, weeping and draining.
- K. Formed Metal and Panel Profile: Lines, breaks and angles shall be sharp, true and surfaces free from warp or buckle.
- L. Form metal and metal panels to profiles, sizes and shapes shown. Provide openings as detailed. Form metal sections to provide flush meeting edges without metal-to-metal laps at joints or exposed metal edges, unless otherwise shown.
- M. Form metal and metal panel miters and copes to be tight fitting, square and in true alignment. Close exposed corners and seams by forming procedures or by welding, brazing or soldering and grinding smooth and flush on exposed surfaces. For exposed metal finishes, use filler metals that will blend and match metal being joined. Comply with requirements of AWS and NAAMM for welding, brazing and soldering.
- N. Consider clearances with adjacent materials and provide correct procedures for erection. Shop assemble and disassemble prior to shipment, mark pieces for field assembly. Provide compatible supports, anchoring devices, anchor bolts, screws, clips, seals and gaskets, and other accessories. exposed fasteners.

- O. Welding: In accordance with appropriate recommendations of American Welding Society use proper procedures. Welds behind finished surfaces shall be accomplished so as to minimize distortions and discoloration on finished side. Remove weld spatter and welding oxides from finished surfaces by descaling and grinding. Grind and polish weld beads on exposed surfaces to match and blend with finish on adjacent parent metal.
- P. Maximum allowable panel fabrication tolerances:
 - 1. Panel Width or Length:
 - a. ± 0.032 inch up to 48 inches wide.
 - b. ± 0.064 inch from 48 inches to 144 inches wide.
 - 2. Panel Thickness:
 - a. ± 0.008 inch.
 - 3. Panel Squareness:
 - a. ± 0.1875 inch difference between diagonal measurements.
 - 4. Panel Camber:
 - a. $+ 0.032$ inch.
 - 5. Panel Bow:
 - a. $+ 0.2$ percent of panel dimension, not to exceed 0.1875 inches.

2.4 SEALANT

- A. Sealant Materials: As specified in Section 079000 – Joint Protection.

2.5 FINISH

- A. Exposed Aluminum:
 - 1. High Performance Pigmented Organic Coatings: AA-C12C423R1x. Cleaned with inhibited chemicals, coated with acid-chromate-fluoride-phosphate treatment, and painted with organic coating as specified below. Prepare, pre-treat and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
 - a. Fluorocarbon Coating: PVDF fluorocarbon coating complying with AAMA 605.2, minimum 70 percent. Same finish shall be used for all exposed aluminum.
 - b. Color: Custom color as selected by Architect.
- B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq ft.
- C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine wall structure system support and conditions under which metal panel system work is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Coordinate dimensions, tolerances and method of attachment with other work.

3.3 INSTALLATION

- A. Install formed metal and metal building panel system on walls in accordance with manufacturer's instructions.
- B. Protect panel surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Provide alignment attachments and shims required to permanently fasten system to building and column structure.

- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Do not cut, trim, weld or braze component parts during erection in manner which would damage finish, decrease strength, or result in visual imperfection or failure in performance. Return component parts which require alteration to shop prefabrication, if possible, or for replacement with new parts.
- F. Install panels in location and alignment indicated, plumb and level with adjacent work. Anchor securely in manner shown, using concealed anchorages wherever possible.
- G. Permanently fasten panel system to wall structure, align, level, and plumb, within specified tolerances.
- H. Remove protective coverings and clean finished surfaces as recommended by panel manufacturer.
- I. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

3.4 TOLERANCES

- A. Panel Erection Tolerances: Erect formed metal panel sheet metal work plumb and true, in alignment and in relation to lines and dimensions shown. Variations of 1/8 inch in 10 feet, non-accumulative, is maximum permissible for plumb, warp, bow and alignment.

END OF SECTION

SECTION 074456
MINERAL FIBER REINFORCED CEMENTITIOUS PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fiber cement panels of the following types:
 - 1. Through color high density fiber cement panels (SDG).

1.2 RELATED SECTIONS

- A. Section 050000 - Metals.
- B. Section 060000 - Wood.
- C. Section 072100 – Thermal Insulation.
- D. Section 072670 - Moisture Barriers: Exterior wall moisture barrier.

1.3 REFERENCES

- A. ASTM International (ASTM):
 - 1. ASTM C 1185 - 08 Standard Test Methods for Sampling and Testing Non-Asbestos Fiber-Cement Flat Sheet, Roofing and Siding Shingles, and Clapboards.
 - 2. ASTM C 1186 - 08 Standard Specification for Flat Fiber-Cement Sheets.
 - 3. ASTM E 84 - Surface Burning Characteristics of Building Materials.
 - 4. ASTM E 136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degree C.

1.4 SUBMITTALS

- A. Submit under provisions of Section 013300 - Administrative Requirements.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
- C. Preparation instructions and recommendations.
- D. Storage and handling requirements and recommendations.
- E. Installation methods.
- F. Shop Drawings: Provide detailed drawings of non-standard applications of fiber cement materials which are outside the scope of the standard details and specifications provided by the manufacturer.
- G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Minimum of 2 years experience with installation of similar products.
- B. Color Evaluation: No change, 2000 hours of accelerated weathering with color evaluation, CCHD Performance Test Report.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.

3. Remodel mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 PROJECT CONDITIONS

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

PART 2 PRODUCTS

2.1 THROUGH COLOR HIGH DENSITY FIBER CEMENT PANELS

- A. (SDG) Through Color High Density Fiber Cement Panels:
 1. Application: Exterior.
 2. Thickness: 5/16 inch (8 mm).
 3. Finish: Through-colored, weather-proof muted matt finish.
 4. Color: as selected by Architect.

2.2 MISCELLANEOUS CLADDING MATERIALS

- A. Perforated Insect/Vermin Screen: Manufacturer's standard.
- B. Aluminum Joint Closures and Decorative Corner Profiles: Manufacturer's standard products as detailed. Maximum thickness of finishing profile to be 0.8 mm or 21 gauge.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 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.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved submittals.
- B. For exterior applications, comply with local codes and structural engineer's fastening calculations along with manufacturer's recommendations for fastener spacing.

3.4 EXTERIOR CLADDING FOR RAINSCREEN APPLICATIONS

- A. Detailing Requirements:

1. Air space at top and bottom of building or wall termination shall be 1/2 inch to 3/4 inch to facilitate airflow from behind the panels. Do not block vertical airflow at windows, doors, eaves, or at the base of the building. Airflow shall be continuous from bottom to top so there is air movement behind each panel. For walls over 60 feet high, the ventilated cavity between rear of panels and exterior wall shall be increased to 1-1/4 inches. Air flow behind the cement fiber panels is critical to the performance of the rain screen constructions.
 2. Fasteners in profile shall accommodate thermal expansion/contraction of metal and not interfere with panel application.
 3. Install panels from top of building to bottom.
 4. For straight walls, start panel installation in center and work outward.
 5. For walls with inside corners, start installation at corner and work across wall.
- B. Rain Screen Installation: Comply with manufacturer's installation requirements.

3.5 PROTECTION

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

END OF SECTION

SECTION 075400 THERMOPLASTIC MEMBRANE ROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Mechanically anchored thermoplastic single ply membrane roofing.
 - 2. Flashing, adhesive, in-seam sealant, splicing cement, lap sealant, mastic, sealer and wood nailers, in connection with thermoplastic sheet roofing.
 - 3. Thermal barrier.
 - 4. Manufacturer's standard 10-year warranty.
 - 5. Protection of roofing.
- B. Related Sections:
 - 1. Section 061000 - Carpentry: Wood curbs and nailers.
 - 2. Section 071413 – Hot-Fluid Applied Rubberized Asphalt Waterproofing,
 - 3. Section 072100 - Building Insulation: Other insulation.
 - 4. Section 076210 - Prefinished Flashing and Sheet Metal.
 - 5. Section 077233 - Roof Hatches.
 - 6. Section 079000 - Joint Sealers: Other sealants.

1.2 REFERENCES

- A. American Society for Testing Materials (ASTM).
- B. Factory Mutual Engineering Corporation (FM) Class 1 Fire Resistance and I-60/90 Wind Uplift Specifications and Loss Prevention Bulletins (1-28, 1-29S, 1-49).
- C. Underwriters Laboratories Inc. (UL).
- D. Warnock Hersey International.
- E. North American Insulation Manufacturers Association (NAIMA).
- F. Single Ply Roofing Institute (SPRI): Wind Design Guide for Mechanically Fastened Roofing Systems.

1.3 SYSTEM DESCRIPTION

- A. (TPO-1): Mechanically anchored thermoplastic single ply membrane over flat insulation (R-25) with thermal barrier and vapor retarder on metal decking.
- B. (TPO-2): Mechanically anchored thermoplastic single ply membrane over flat insulation (R-25) with vapor retarder on metal decking (no thermal barrier required).
- C. (TPO-3): Mechanically anchored thermoplastic single ply membrane over flat insulation (R-25) with vapor retarder on concrete decking (no thermal barrier required).
- D. (TPOT-4): Mechanically anchored thermoplastic single ply membrane over tapered insulation (R-25) and vapor retarder on wood decking (no thermal barrier required).

1.4 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300, indicating roof size, location and type of penetrations, perimeter and penetration details, roof insulation make-up and layout that have been accepted by authorized manufacturer's representative.
- B. Testing: Submit 2 copies of fastener test results.
- C. Compliance: Submit compliance from insulation manufacturer that insulation furnished conforms to specified product.
- D. Warranty: Submit 2 copies of manufacturer's warranty for thermoplastic sheet single ply roofing.

- E. Deviation to Details: If deviations to indicated details are desired, submit proposed detail changes not later than 10 days prior to bid date.
- F. Installation Instructions: Submit two copies of Manufacturer's installation instructions in accordance with Section 013300.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Manufacturer shall assure qualifications of installer and suitability and compatibility of system.
 - 1. Prime Manufacturer: History of successful installations minimum ten years old.
- B. Approved Applicator: Applicator shall have not less than 3 years of successful experience in installation of similar roofing systems and shall be certified in writing by manufacturer as a licensed or approved applicator.
- C. Inspections for Warranted Roofs: Conducted by technical employee of manufacturer, not sales representative, unless sales representative is factory authorized inspector.
- D. Pre-Roofing Conference: Prior to installation of roofing and associated work, meet at project site with installer, roofing manufacturer, installers of related work, and other entities concerned with roofing performance. Record discussions and agreements and furnish copy to each participant.
 - 1. Provide at least 72 hours advance notice to participants prior to convening pre-roofing conference.
- E. FM Listing: Sheet membrane, base flashings and component materials shall comply with FM 4450 and FM 4470 and are listed in FM's "Approval Guide" for Class 1 or non-combustible construction as applicable.
- F. Compatibility: All roofing components shall be compatible.
- G. Wind Uplift: Secure roofing to comply with Factory Mutual FM-I-90 requirements.

1.6 PRODUCT HANDLING

- A. Deliver thermoplastic sheet single ply roofing material in manufacturer's protective containers, and comply with manufacturer's instructions for storage and handling.

1.7 PROJECT/SITE CONDITIONS

- A. Proceed with installation of mechanically attached thermoplastic sheet single ply roofing only after substrate construction has been completed, and after penetrating components have been installed, so that membrane will not be penetrated or damaged by subsequent work.
- B. Weather Conditions: Proceed with mechanically attached thermoplastic sheet single ply roofing work only when weather conditions comply with manufacturer's recommendations, and will permit materials to be applied and cured in accordance with those recommendations. Do not exceed temperature limitations recommended by roofing manufacturer.

1.8 WARRANTY

- A. Completed mechanically attached thermoplastic sheet single ply roofing installation shall be warranted by sheet roofing manufacturer, in accordance with manufacturer's standard warranty, for period of 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 VAPOR RETARDER

- A. Fully adhered membrane: 32 mil thick unreinforced membrane with a permeability rating of 0.05 perms (ASTM E-96), compatible with adhesive. Provide vapor retarder required by membrane manufacturer consistent with system warranty so that all components are from a single manufacturer and each component of roof system is included in warranty.

1. Primer and Adhesive: Follow manufacturer's written instruction for application of primer and vapor retarder on approved substrates. VOC: less than 100 g/l.
2. Select Primer capable of withstanding moisture exposure.

2.2 THERMAL BARRIER

- A. Type: 5/8 inch UL rated gypsum roof board.

2.3 ROOF INSULATION

- A. Polyisocyanurate Foam Board: Closed cell polyisocyanurate foam core with laminated black glass reinforced mat facer complying with ASTM C 1289.
 1. Density: 2.0 pcf per ASTM D1622
 2. Compressive Strength: 25 psi minimum per ASTM D1621 Procedure A
 3. Meets FM 4450 and UL 1256.
 4. Moisture Vapor Transmission: 1.0 perms maximum.
 5. Thickness: Provide thickness and slope as indicated. Provide minimum of 3 inches.
 6. R-Value: 5.6 design stabilized R-value according to RIC/TIMA Bulletin No. 101.
- B. Factory taper insulation to provide smooth incline of slopes as shown on drawings. Factory miter valleys and corners.
- C. Multiple Layers: Furnish in not less than 2 layers.
- D. Insulation Fasteners: Refer to Membrane Fasteners specified herein.

2.4 MECHANICALLY ANCHORED THERMOPLASTIC SINGLE PLY MEMBRANE ROOFING

- A. Mechanically anchored 60 mil thick thermoplastic alloy with polyester reinforced weft, thermoplastic sheet roofing system.
- B. Sheet Membrane: Minimum 0.060 inch thick compounded thermoplastic membrane, largest sheet size possible as determined by membrane manufacturer.
- C. Flashing: Minimum 0.045 inch thick. Provide longest pieces of flashing practicable.
- D. Miscellaneous Accessories: Bonding adhesive, pourable sealers, splicing cement, lap sealant, water cut-off mastic, and preformed cone and vent sheet flashing and inside and outside corner sheet flashing, T-joint covers, seam caulk, tape, termination reglets and other accessories: As recommended by membrane roofing manufacturer.
- E. Kraft Paper: Heavy duty type. Provide 12 inch wide strips under splices over polystyrene insulation to protect insulation from splicing materials.
- F. Compressible tube joint filler.
- G. Nailers, Blocking: No. 2 or better dimensional lumber, pressure-treated for rot resistance as specified in Section 061000 - Carpentry.
 1. Provide drilled at 6 inch on center, or pre-drilled rubber fastening strip for membrane nailer strip as recommended by manufacturer.
- H. Walkway Protection: Sized membrane pads, adhered to roof membrane.
 1. Compatible adhesive.

2.5 MEMBRANE FASTENERS

- A. Fasteners (Mechanical Fastening): Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance requirements of FM 4470, and as recommended by roofing manufacturer.
 1. Insulation Plates: Corrosion-resistant type plates as specified above.
- B. Metal Battens: Manufacturer's standard aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.
 1. Batten Layout Category: Follow category securement requirements as recommended by manufacturer for intended use.

- C. Membrane Nailer to Wood: Coated screws of sufficient length to penetrate minimum one inch into wood or masonry substrate. Install screws using manufacture's approved screw guns.
- D. Metal Termination Bars: Manufacturer's standard aluminum bars, approximately 1 inch wide, roll formed and prepunched.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate and conditions under which elastic sheet roofing work is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Verify that penetrations, expansion joints, and blocking are in place and secured and that roof drains are properly clamped into position.

3.2 ROOFING CUT-OFFS

- A. Coordinate installation so that each area is made watertight at the end of each work period. Provide water cut-offs by extending the membrane beyond the insulation and securely setting the edge of the membrane into 6 inch wide band of plastic roofing cement and placing weight on the adhered edge to prevent displacement.
 - 1. Remove cut-offs prior to the start of the next work period by cutting of the membrane section in contact with the plastic roofing cement and disposing of it.

3.3 SUBSTRATE PREPARATION

- A. Comply with sheet membrane manufacturer's instructions for preparation of substrate to receive thermoplastic sheet roofing.
 - 1. Clean substrate of dust, debris and other substances detrimental to thermoplastic sheet roofing work.
 - 2. Install slip sheet if recommended by membrane manufacturer.

3.4 THERMAL BARRIER

- A. Lay thermal barrier without adhesive perpendicular to roof deck direction with end joints occurring over crests of steel deck and staggered 2 feet in adjacent rows.
 - 1. Neatly cut and fit around penetrations and projections.
 - 2. Install only as much thermal barrier as can be covered same day with vapor retarder, insulation and membrane.

3.5 VAPOR RETARDER

- A. Install vapor retarder using approved primer on all substrates, in a single layer, shingle fashion from low to high, with all laps 2 -1/2 inches minimum and end laps staggered, each sheet.
 - 1. Apply adhesive at rate recommended by vapor-retarder manufacturer. Seal laps with adhesive approved by FMG's Approval Guide.
- B. Completely seal vapor retarder at terminations, obstructions, and penetrations to prevent air movement into membrane roofing system.

3.6 ROOF INSULATION

- A. Install and secure roof insulation to roof deck in accordance with manufacturer=s requirements. Stagger joints between layers, minimum of 2 layers. Insulation joints shall be 1/4 inch or less in width.
 - 1. Neatly cut and fit insulation around roof penetrations and projections. Install only dry insulation and only as much insulation as can be covered same day with membrane.
 - 2. Install tapered insulation around roof drains to provide proper slope for drainage.
- B. Recovery Board: Place immediately under roofing membrane with joints staggered from insulation below.

1. Secure insulation boards with fasteners and insulation plates to roof deck:
- C. Steel Decking: Minimum 1/2 inch fastener penetration through the deck using minimum of 16 fasteners per 4 foot by 8 foot board and with additional fasteners at perimeter and corners as required by FM-I-90.
 1. Test fasteners for pull-out resistance as specified.

3.7 WOOD NAILERS

- A. Wood nailer height shall match total thickness height of insulation being used and shall be installed with 1/8 inch gap between each length of wood nailer.
 1. Fasten wood nailers to deck or wall at maximum 16 inch on center in manner to resist force of 200 pounds per foot in any direction.
 2. Where nailers are required to be flush at point of contact with roofing membrane, taper wood nailers.

3.8 MECHANICALLY FASTENED SHEET ROOFING INSTALLATION

- A. Install thermoplastic sheet single ply membrane roofing to exclude water in accordance with manufacturer's printed instructions.
 1. Install Kraft paper under splices over polystyrene insulation.
 2. Field weld or Join seams of thermoplastic sheet roofing material by thoroughly solvent washing, brush applied primer, if required, and brush applied solvent.
 3. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of the roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.
- B. Loosely lay sheet membrane over roof insulation and allow membrane to relax before fastening or splicing.
 1. Apply adjoining sheets by lapping edges a minimum of 3 inches and splicing. Thoroughly seal laps, including use of lap seal as final application. Stagger end laps.
 2. Apply roofing sheet with side laps shingled with slope of roof deck.
 3. Mechanically fasten membrane at terminations, to nailers and around penetrations using membrane fasteners. Install membrane at wood or masonry with screw gun.
 4. At in-seam attachment, secure one edge of sheet using fastening plates or battens centered within the membrane seam and mechanically fasten sheet to roof deck. Field-weld or join seams as specified.
 5. Test lap edges with probe to verify seam weld continuity. Apply seam caulk to seal cut edges of sheet membrane.
- C. Complete splice between flashing and sheet roofing before bonding flashing to vertical surface. Adhesively apply flashing and nail at top of flashing.
 1. Flash penetrations passing through sheet membrane and field-formed inside and outside corners as recommended by manufacturer.
 2. Install flashing where indicated, extend vertically minimum of 8 inches.
 3. Clean seam areas, overlap sheets, and firmly roll flashings into adhesive. Weld side and end laps to ensure a watertight seam installation.
 4. Test lap edges with probe as specified.
 5. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.
- D. Roof Drains: Comply with membrane manufacturer's and drain manufacturer's recommended installation procedures.
 1. Spread sealant bed over deck drain flange at deck drains and securely seal roofing sheet in place with clamping ring.
- E. Walkway Protection: Install paver units at locations shown and where required for access to roof mounted equipment. Place pavers carefully to avoid damage to membrane, laying over additional layer of roof membrane material.

3.9 FIELD QUALITY CONTROL

- A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion and submit report to Architect.
 - 1. At end of construction period, or at time when remaining construction will in no way affect or endanger roofing, make final inspection of roofing and prepare written report to Owner, describing nature and extent of deterioration or damage found.
 - 2. Notify Architect 48 hours in advance of the date and time of inspection.

3.10 PROTECTION OF ROOFING

- A. Upon completion of roofing (including associated work), institute appropriate procedures for surveillance and protection of roofing during remainder of construction period. Maintain roof free of nails, screws, scrap and other foreign objects.
- B. Repair or replace (as required) deteriorated or defective work found at time of final inspection to condition free of damage and deterioration at time of Substantial Completion and in accordance with requirements of specified warranty.

END OF SECTION

SECTION 076100 SHEET METAL ROOFING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Metal roofing and flashing.
 - 2. Concealed clips, fasteners, concealed sealant, slip sheet, waterproof membrane, and underlayment.
 - 3. Roofing at sloped roof, including trim, roof edge, metal chimney saddle, and fascia with drip.
 - 4. Gutters and downspouts of same material.
 - 5. Thermal barrier, rigid insulation and batt insulation.
- B. Related Sections:
 - 1. Section 061000 - Rough Carpentry: Wood blocking and plywood sheathing.
 - 2. Section 072100 - Thermal Insulation: Other rigid insulation.
 - 3. Section 075400 - Thermoplastic Membrane Roofing.
 - 4. Section 076210 - Sheet Metal Flashing and Trim.
 - 5. Section 079000 - Joint Protection.

1.2 REFERENCES

- A. NAAMM - Metal Finishes Handbook.
- B. SMACNA - Architectural Sheet Metal Manual.

1.3 DESCRIPTION

- A. (SMR) Sheet Metal Roofing: Zinc sheet metal standing seam roofing with all accessory materials, including waterproof membrane.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Uplift Resistance: Provide sheet metal roofing capable of resisting design negative uplift pressure as indicated. Provide clips, fasteners, and clip spacing of type indicated and with capability to sustain, without failure, load equal to 3 times design negative uplift pressure.
- B. Thermal Movements: Provide sheet metal roofing that allows for thermal movements resulting from change in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealant, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as result of sheet metal thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- C. Water Infiltration: Provide sheet metal roofing that does not allow water infiltration to building interior, with metal flashing and connections of sheet metal roofing lapped to allow moisture to run over and off material.

1.5 SUBMITTALS

- A. Shop Drawings and Product Data: Submit in accordance with Section 013300. Indicate material profile, jointing pattern, jointing details, fastening methods, installation details, location and type of penetrations and connections and transitions.
- B. Submit manufacturer's installation instructions.
- C. Samples: Submit in accordance with Section 013300. Provide sample of metal roofing mounted on plywood backing illustrating typical seam, external corner, internal corner, valley, ridge, junction to vertical dissimilar surface; material and finish.
- D. Warranty: Submit 2 copies of manufacturer's written warranty.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Installation of sheet metal roofing shall conform to accepted industry standards and be accomplished by manufacturer's approved installer, in accordance with Sheet Metal Contractors Association Handbooks and recommendations and to details shown.
- B. Preinstallation Meeting: Prior to installation of roofing and associated work, meet at project site with installer, roofing manufacturer, installers of related work, and other entities concerned with roofing performance. Record discussions and agreements and furnish copy to each participant. Provide at least 72 hours advance notice to participants prior to convening pre-roofing conference.

1.7 STORAGE AND HANDLING

- A. Stack preformed and prefinished material to prevent twisting, bending, or abrasion, and to provide ventilation.
- B. Prevent contact with other materials or metals during storage which may cause discoloration or staining.
- C. Deliver materials in manufacturer's protective covering. Comply with manufacturer's recommendations for handling, storage and protection during installation. Store materials off ground under waterproof covering. Do not expose strippable film finish protection to ultraviolet rays of sunlight, remove immediately after installation.

1.8 COORDINATION

- A. Coordinate sheet metal roofing with other trades to insure proper installation of sheet metal roofing.

1.9 WARRANTY

- A. Special Weathertight Warranty: Provide 30 year manufacturer's written warranty agreeing to repair or replace sheet metal roofing that fails to remain weathertight after completion and final acceptance of the work.
- B. Special Finish Warranty: Submit manufacturer's 20 year written warranty covering failure of the factory-applied exterior finish on metal roofing and agreeing to repair finish or replace sheet metal roofing that evidences finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Type and Manufacturer (SMR): Zinc single locked riveted standing seam roofing system.

2.2 SHEET MATERIALS

- A. Combined Alloy Metal: Architectural-grade zinc alloy consisting of 99.995% pure zinc combined with controlled amounts of copper and titanium.
 - 1. Composition (% by wt.)
 - a. Copper: 0.10 to 0.25
 - b. Titanium: 0.06 to 0.10
 - c. SHG (Special High Grade) Zinc (99.995% pure): balance
 - 2. Physical and Mechanical Properties
 - a. Density (lb/in³): 0.259
 - b. Melting Point (°F): 792
 - c. Coefficient of Thermal Expansion (µin/in•°F): 15.4
 - d. Electrical Conductivity (% IACS): 26
 - e. Electrical Resistivity (Ω•cir. mil/ft): 39.58
 - f. Thermal Conductivity (BTU/ft•hr•°F): 60.5
 - g. Shear Strength (ksi): 24-28
 - h. Tensile Strength (ksi): 21 to 28
 - i. Hardness (Rockwell 15T): 50 to 68

- j. % Elongation (in 2"): 30-45
- k. Yield strength: ~28,000 psi
- l. Min. Cold Form Bend Radius: 3T (up to 0.032" sheet thickness)
4T (over 0.032" sheet thickness)

2.3 FINISH

- A. Zinc Finish: Pre-weathered Gray finish providing look of naturally weathered patina finish.

2.4 BUILDING PAPER

- A. Building Paper Slip Sheet: Red-rosin type and size building paper, 3 lb/100 sq. ft. minimum weight.

2.5 ACCESSORY MATERIALS

- A. Fasteners: Stainless steel threaded fasteners with soft neoprene washers. Provide concealed clip system. Screws minimum 1-1/2 inch long. Exposed surfaces with finish to match color of sheet metal roofing.
- B. Waferboard Underlayment: ANSI A208.1; APA Certified 3/8 inch thick.
- C. Protective Backing Paint: Zinc chromate alkyd or Bituminous.
- D. Solder: FS QQ-S-571.
- E. Flux: FS O-F-506.
- F. Slip Sheet: Rosin sized building paper.
- G. Sealant: As specified in Section 079000 - Joint Protection.
- H. Bedding Compound: Rubber asphalt type.
- I. Plastic Cement: Asphaltic cement.
- J. Waterproof Membrane: Cold-applied self-adhering membrane of rubberized asphalt integrally bonded to polyethylene sheeting.
- K. Plastic Flashing: 30-mil thick vinyl flashing.
- L. Thermal Barrier: 5/8 inch Type X core gypsum board.
- M. Mineral Fiber Board Insulation: Perlite roof insulation in 2 layers, thickness as indicated.

2.6 FABRICATION

- A. Fabricate cleats and starter strips of same material as sheet, interlockable with sheet.
- B. Form pieces in longest practical lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material for standing seam in accordance with sheet metal contractors handbook and recommendations for roofing. Lap joints in direction of flow.
- E. Back paint concealed metal surfaces with protective backing paint.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate and conditions under which sheet metal roofing is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.
- B. Examine roughing-in for components and systems penetrating sheet metal roofing to verify actual locations of penetrations relative to seam locations of sheet metal roofing before installation.

3.2 INSPECTION

- A. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves, or projections, properly sloped to drains, valley, or eaves.
- B. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
- C. Verify deck is dry and free of snow or ice. Flutes in steel deck shall be clean and dry. Joints in wood deck shall be solidly supported and nailed. Joints in underlayment shall be solidly supported and nailed.

3.3 INSTALLATION

- A. Execute metal work in accordance with sheet roofing standards, recommendations and manufacturer's instructions.
- B. Install waterproof membrane directly over substrate where indicated. Install membrane in accordance with manufacturer's directions to maintain waterproof integrity of material and installation. Lengths shall be as long as possible by rolls of material. Lap ends minimum 2 inches, seal entire lap with adhesive as recommended and clean free of residue.
- C. Apply slip sheet in one layer, laid loose.
- D. Loosely lay roof insulation with joints staggered. Stagger joints between layers. Insulation joints shall be 1/4 inch or less in width. Neatly cut and fit around penetrations. Install only dry insulation and only as much as can be covered in one day.
- E. Lap, lock, cleat, seam, and seal joints. Use rubber asphalt bedding compound for joints between metal and bitumen or metal and felts.
- F. Install starter and edge strips, and cleats before starting installation of roofing sheets.
- G. Stagger (Align) joints of roofing joints.
- H. Provide metal pans for protrusions through roof such as vents, conduits, or structural steel hangars. Fill pockets with plastic cement.
- I. Back paint surfaces in contact with dissimilar materials. Moisture from one metal shall not drain onto another metal.
- J. Install work with proper allowance for expansion and contraction from thermal changes.
- K. Lay thermal barrier over roof deck with joints staggered. Neatly cut and fit around penetrations. Install only as much as can be covered in same day by insulation, underlayment, slip sheet and membrane.
- L. Solder and seal metal roofing joints. After soldering, wash metal clean with neutralizing solution, rinse with water.
- M. Apply concealed sealant in accordance with requirements of Section 079000 - Joint Sealers.
- N. Lower edge of flashing, counterflashing and exposed metal edges shall be turned back into hemmed edge, 1/2 inch high.
- O. Construction of end joints in metal flashing shall comply with Section 076210 – Sheet Metal Flashing and Trim, with backplate for expansion.
- P. Install plastic flashing as liner directly under sheet metal where indicated. Install plastic flashing in accordance with manufacturer's directions to maintain watertight integrity of flashing materials and installation. Lengths shall be as long as possible by rolls of material. Lap ends minimum 2 inches, seal entire lap with adhesive (not pitch or plastic cement). Wipe talc off material and clean free of other residue.

3.4 STANDING SEAM ROOFING

- A. Install standing seam roofing in accordance with reviewed shop drawings and manufacturer's printed instructions.

- B. Use proper sized sheets with standing seams 16 inches o.c. without straight run of standing seam exceeding maximum length.
- C. Fold lower end of each pan under 3/4 inch. Slit fold one inch away from corner to form tab where pan turns up to make standing seam. Fold upper end of each pan over 2 inches. Hook 3/4 inch fold on lower end of upper pan 2 inches into fold on upper end of underlying pan.
- D. Apply pans beginning at eaves. Loose lock pans to valley flashing and edge strips at eaves and gable rakes.
- E. Finish standing seams one inch high on flat surfaces and 1/2 inch high on curved surfaces. Bend up one side edge 1-1/2 inch and other 1-3/4 inch. Make first fold 1/4 inch wide single fold and second fold 1/2 inch wide, providing locked portion of standing seam with 5 plies in thickness. Fold lower ends of seams at eaves over at 45 degree angle. Terminate standing seams at ridge and hips by turning down in tapered fold.
- F. Carefully form flashings to conform to material dimensions as shown and according to field dimensions as verified.
- G. Apply concealed sealant in accordance with requirements of Section 079000 - Joint Sealers.
- H. Form valleys of sheets not exceeding 10 feet in length. Lap joints 6 inches in direction of drainage. Extend valley sheet minimum 6 inches under roofing sheets. At valley, double fold valley and roofing sheets and secure with cleats spaced 18 inches o.c.

3.5 BUILT-IN GUTTERS

- A. Longitudinal joints not acceptable.
- B. Secure gutter lining to substrate with cleats spaced as indicated along edges of gutters.
- C. At roof edges extend gutter lining under metal roofing 6 inches minimum and terminate in 3/4 inch folded edge secured by cleats. Hook lower end of roofing into lock strip to form 3/4 inch wide loose-lock seam.
- D. Seal watertight joint of gutter to drain or scupper with sealant.

3.6 CLEANING

- A. Thoroughly clean metal roofing as recommended by manufacturer to remove loose soil and dirt.

3.7 FIELD TESTING AND INSPECTION

- A. Water test waterproof membrane prior to installing metal roof system.
- B. Inspect membrane as it is being installed to assurance waterproof integrity of membrane.

END OF SECTION

SECTION 076210

PREFINISHED SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Prefinished sheet metal flashing, roof edge, coping, expansion and contraction joint covers, parapet wall covers.
 - 2. Counter flashings for roof hatches and roof mounted mechanical equipment/services.
 - 3. Membrane flashing liner under metal flashing and sheet metal.
 - 4. Shop fabricated interior and exterior corners for roof edge flashing, copings, base flashing, and counterflashing, where applicable.
 - 5. Sealant concealed within sheet metal.
- B. Related Sections:
 - 1. Section 061000 - Rough Carpentry: Wood blocking, nailers, grounds.
 - 2. Section 079000 - Joint Protection: Exposed sealants.

1.2 REFERENCES

- A. "Architectural Sheet Metal Manual" standard industry details by SMACNA.

1.3 PERFORMANCE REQUIREMENTS

- A. Install sheet metal and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking and fastener disengagement.
- B. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300.
 - 1. Clearly detail shaping, jointing, length of sections, fastening, and installation details.
- B. Samples: Submit in accordance with Section 013300 indicating metal finish.
- C. Warranty: Submit 2 copies of manufacturer's written warranty.

1.5 QUALITY ASSURANCE

- A. High performance roof edge system shall be certified by the manufacturer and/or fabricator to comply with ANSI/SPRI Standard ES-1.

1.6 PROJECT/SITE CONDITIONS

- A. Exercise care when working on or about roof surfaces to avoid damaging or puncturing membrane or flexible flashings.
- B. Coordinate work of this section with interfacing and adjoining work for proper sequencing of each installation. Ensure best possible weather resistance and durability of work and protection of materials and finishes.

1.7 WARRANTY

- A. Special Finish Warranty: Submit manufacturer's 20 year written warranty covering failure of the factory-applied exterior finish on sheet metal and agreeing to repair finish or replace sheet metal that evidences finish deterioration. Deterioration of finish includes, but is not limited to, color fade, chalking, cracking, peeling, and loss of film integrity.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Type and Manufacturer (SMF): Pre-finished aluminum flashing, ASTM B 209 alloy, shop coated with fluoropolymer coating in color as selected by Architect.
- B. Anchorage: Nails and screws of hot dip zinc coated steel. Use screws where exposed anchorage is required. Screws minimum 1-1/2 inch long with neoprene washer under screw head. Exposed surfaces with finish to match color of sheet metal.
- C. Concealed curtain wall sealant.
- D. Membrane Flashing:
 - 1. (MEMB FLASH) EPDM Rubber Sheet Membrane Flashing: ASTM D 6134, Type I, 60-mil-thick flexible sheet, unreinforced, formed from EPDM.
 - 2. Accessories: Furnish auxiliary materials including sheet flashing and bonding adhesive, recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.

2.2 FABRICATION

- A. Factory fabricate metal flashing and sheet metal in accordance with reviewed shop drawings and standard industry details by SMACNA in "Architectural Sheet Metal Manual."
 - 1. Provide interior and exterior corners, where applicable to site conditions.
- B. Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrate and conditions under which flashing and sheet metal work is to be performed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install sheet metal work in accordance with reviewed shop drawings and Architectural Sheet Metal Manual with sharp clean breaks.
- B. Lower edge of flashing, counter flashing and exposed metal edges shall be turned back into hemmed edge.
- C. Flashing shall be securely fastened and water and weatherproof. Neatly install with sharp clean breaks. Metal work at roof shall meet roofer's requirements and approval.
- D. Butt and locked joint in metal work shall be watertight. Joints shall be lapped in direction of flow.
- E. Provide lead wedges where required to hold metal firmly in place.
- F. Install work with proper allowance for expansion and contraction from thermal changes.
- G. Prior to starting work, nailers and blocking shall be true to size and line and securely anchored. Do not proceed until corrections are made so straight, level, plumb and properly sized work results.
- H. Carefully form flashings, including at masonry, to conform to material dimensions as shown and according to field dimensions as verified.
- I. Join lengths of gutters and downspouts with formed seams sealed watertight. Flash and seal gutters to downspouts. Slope gutters to downspout.

3.3 LOCATION OF JOINTS IN METAL

- A. Center roof edge cover joints on other building features, symmetrical on facade, with joints not to exceed 10 feet o.c., as directed by Architect.

- B. Joints in other metal work may be placed where convenient to metal lengths, not to exceed 10 feet lengths.
- C. Cut metal for installations to maintain uniform 1/4 inch joint.

3.4 TYPES OF METAL END JOINTS

- A. Flush, butt type with backplate for expansion at: Roof edge covers and expansion joint covers.
- B. Cover strip over joint, with single lock seam: Typical curb covers.
- C. Lapped joints at: Counter flashing, reglets, and similar cover type metal.

3.5 CONSTRUCTION OF END JOINTS

- A. Butt Joints with Backplate for Expansion: Provide backplates same gauge and metal as flashing, 6 inch wide (2-7/8 inch each side of joint) conforming to exact shape of back of metal and full profile of metal after forming (except hems).
 - 1. At both ends of each length of flashing metal, provide not less than 3 bent clips riveted near end, to receive backplate. Backplates are to slip under bent clips and shall form tight contact with flashing or cover metal.
 - 2. In installation, butter bed of sealant on backplate and slide section of metal onto backplate, such that backplate fits into clips to hold metal tight and in perfect alignment. Repeat until metal has been set. At joints, install screws with neoprene washers through backplate without fastening to metal flashing length. (Notch out ends of flashing metal to accommodate screw heads and to eliminate obstructions for metal expansion.) Provide screw with neoprene washer at center of each length of roof metal flashing. Provide keepers or cleats to keep metal in place.
- B. Locked Cover Strips: Cover strip shall have same profile as flashing and be formed with single lock seam to metal each side of joint. Locked seam joints shall have about 3/4 inch seam lock, with flashing spaced about 3/8 inch and shall permit movement at each joint.
- C. Lapped Joints: Lap 3 inches in direction of water flow. At counterflashings, lock bottom edges together.
- D. Sealant: Apply concealed sealant in accordance with requirements of Section 079000 - Joint Sealers.
- E. At corners, inside or outside type, provide neat corner sections built-up in shop; with soldered joints and follow profile of adjacent metal. No nails permitted at exposed surfaces of exposed roof metal, only screws shall be used. Set roof edges in cooperation with roofer. Form angles to lesser degrees than required to insure snug fit after installation.

3.6 MEMBRANE FLASHING

- A. Install membrane flashing as liner directly under sheet metal. Install membrane in accordance with manufacturer's directions to maintain watertight integrity of flashing materials and installation. Lengths shall be as long as possible by rolls of material. Lap ends minimum 2 inches, seal entire lap with adhesive and clean free of residue.

3.7 COUNTERFLASHING AND CURB FLASHING

- A. Install metal counterflashing after membrane flashing is installed. Secure with screws through neoprene washers and locate not to exceed 18 inches o.c. Lap joints and lock lower edges together.
- B. Install counterflashing to provide watertight closure over top of roofing flashing. Corners at curbs shall be sealed watertight. Height of counterflashing above membrane as indicated, with counterflashing carried down 45 degrees cant strip to about 1/2 inch above roof insulation. Bottom edge shall be hemmed (turned back) to eliminate sharp edges.
- C. Counter-flash mechanical and electrical items projecting through membrane roofing.

3.8 CLEANING

- A. Clean exposed metal surfaces, removing substances which might cause corrosion of metal or deterioration of finishes.

END OF SECTION

SECTION 077233 ROOF HATCHES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Prefabricated roof hatches and accessories.
 - 2. Safety railings at roof hatches.
 - 3. Ladder access safety post.
- B. Related Sections:
 - 1. Section 075400 – Thermoplastic Membrane Roofing.
 - 2. Section 076210 - Sheet Metal Flashing and Trim: Flashing roof hatches to roof system.
 - 3. Section 099000 - Painting: Field painting.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, materials, dimensions of individual components and profiles, and finishes.

1.3 QUALITY ASSURANCE

- A. Standards: Comply with the following:
 - 1. SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.
 - 2. NRCA's "Roofing and Waterproofing Manual" details for installing units.

PART 2 PRODUCTS

2.1 ROOF HATCHES

- A. Product (RH): Aluminum roof hatch for vertical ladder access.
 - 1. Size: 3 feet 0 inches by 3 feet 0 inches

2.2 ROOF HATCH FABRICATION

- A. Performance characteristics:
 - 1. Cover: Reinforced to support minimum live load of 40 psf with maximum deflection of 1/150th of the span or 20 psf wind uplift.
 - 2. Cover operation shall be smooth and easy with controlled operation throughout entire arc of opening and closing.
 - 3. Cover operation shall not be affected by temperature.
 - 4. Entire scuttle shall be weathertight with fully welded corner joints on cover and curb.
- B. Cover: 11 gage aluminum with 3 inch beaded flange with formed reinforcing members. Cover shall have a heavy extruded thermoplastic rubber gasket fitted into a retainer mechanically fastened to the cover interior to assure continuous seal when compressed to top surface of curb.
- C. Cover insulation: 1 inch thick fiberglass, fully covered and protected by metal liner 18 gage aluminum.
- D. Curb: 12 inch high; 11 gage aluminum. Curb formed with a 3-1/2 inch flange with 7/16 inch holes provided for securing to the roof deck.
 - 1. Equipped with an integral metal cap flashing of the same gage and material as the curb, fully welded at the corners, with flashing system, including stamped tabs, 6 inch on center, to be bent inward to hold roofing membrane securely in place.
- E. Curb insulation: Rigid, high-density 1 inch thick fiberboard on outside of curb.

- F. Lifting mechanisms: Manufacturer's compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout entire arc of opening and closing. Lower tube shall interlock with flanged support shoe [for aluminum construction: welded to the curb assembly; for steel construction: through bolted to the curb assembly].
- G. Hardware:
 - 1. Hinges: Heavy pintle type.
 - 2. Cover: Equipped with a spring latch with interior and exterior turn handles.
 - 3. Roof scuttle: Equipped with interior and exterior padlock hasps.
 - 4. Latch strike: Stamped component bolted to the curb assembly.
 - 5. Cover: Automatically lock in the open position with a rigid hold open arm equipped with a 1 inch diameter red vinyl grip handle to permit easy release for closing.
 - 6. Compression spring tubes: Constructed of anti-corrosive composite material.
 - 7. Other hardware: Zinc plated and chromate sealed.
 - 8. Springs: Electrocoated acrylic finish for corrosion resistance.
 - 9. Cover hardware: Bolted into heavy gage channel reinforcing welded to the underside of the cover and concealed within the insulation space.
 - 10. Cylinder Lock: Provide roof hatch with Deadbolt cylinder lock, keyed for interior and exterior access. Exterior lock cylinder with gasketed and threaded deck plate.
- H. Finishes: Mill finish aluminum.
- I. Safety Railing: Provide OSHA safety railing system at full perimeter of roof hatches, and attached to roof hatch curb.
- J. Safety Post: Bilco LadderUP safety post Model LU-1 steel with yellow powder coat; telescoping tubular section that locks automatically when fully extended; upward and downward movement controlled by stainless steel balancing mechanism.

PART 3 EXECUTION

3.1 INSPECTION

- A. Verify that roof hatch installation will not disrupt other trades. Verify that the substrate is dry, clean, and free of foreign matter. Report and correct defects prior to any installation.

3.2 INSTALLATION

- A. Install roof hatches in accordance with manufacturer's recommendations.
- B. Coordinate with installation of roofing system and related flashings. Provide weather tight installation.
- C. Anchor units securely to supporting structural substrates, adequate to withstand lateral and thermal stresses as well as inward and outward loading pressures.
- D. Test operate units and adjust for proper operation.
- E. Clean and lubricate joints and hardware.
- F. Install safety railing in accordance with OSHA requirements

END OF SECTION

SECTION 078400 FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Firestop joint sealant and backing, including intumescent elastomeric compounds and sealants.
 - 2. Rigid boards, forms, wraps and accessories.
 - 3. Fiber packing and fiber fill.
 - 4. Wool fiber insulation and fire-safing insulation.
 - 5. Other firestopping as indicated.
- B. Related Sections:
 - 1. Section 079000 - Joint Protection: Other sealants.
 - 2. Section 084400 – Aluminum Curtain Walls, Windows and Entrances: Edge of floor firestopping.
 - 3. Section 092900 – Gypsum Board: Acoustical sealants.
 - 4. Divisions 13 and 14 - Firestopping of penetrations caused by special construction services is specified in Section 078400.
 - 5. Division 21 – Fire Suppression: Firestopping of penetrations caused by fire suppression services.
 - 6. Division 22 – Plumbing: Firestopping of penetrations caused by plumbing services.
 - 7. Division 23 – Heating, Ventilating and Air Conditioning: Firestopping of penetrations caused by mechanical services.
 - 8. Division 26 - Electrical: Firestopping of penetrations caused by electrical services.
 - 9. Division 27 – Communications: Firestopping of penetrations caused by communications services.
 - 10. Division 28 – Electronic Safety and Security: Firestopping of penetrations caused by safety and security services.

1.2 REFERENCES

- A. IEEE #634: Institute of Electrical and Electronic Engineers, Inc., Standard Cable Penetration Fire Stop Qualification Test.
- B. UL 1479: Underwriters' Laboratories, Inc. (UL), Fire Standard Test Used to Classify Products as Standard for Through-Penetration Fire Stops.
- C. UL Systems: XHEZ Series; (Pipe, conduit, cable and bus penetrations). (Table Indexes firestop systems by construction features.)
- D. UL Materials: XHHW Series; (Duct penetrations and building joints). (List of Fill, Void or Cavity materials for use in numbered firestop systems.)
- E. UL Materials, XHKU Series; (Forms and dams) (List of Forming materials for use in numbered firestop systems.)
- F. UL Assemblies: BXUV Series; (Structural floors, partitions and walls.)
- G. NFPA 101: Life Safety Code.
- H. NFPA 258: Standard Test Method for Measuring the Smoke Generated by Solid Materials.

1.3 DEFINITIONS

- A. Assembly: Particular arrangement of materials specific to given type of construction described or detailed in referenced documents.
- B. Barriers: Time rated fire walls, smoke barrier walls, time rated ceiling/floor assemblies and structural floors.
- C. Firestopping: Methods and materials applied in penetrations and unprotected openings to limit spread of heat, fire, gases, and smoke.

- D. Penetration: Opening or foreign material passing through or into barrier or structural floor such that full thickness of rated materials is not obtained.
- E. Construction Gaps: Gaps between adjacent sections of walls, exterior walls, and structural floors or roof decks; and gaps between adjacent sections of structural floors and at wall tops between top of wall and ceiling.
- F. System: Specific products and applications, classified and numbered by Underwriters Laboratories Inc., to close specific barrier penetrations.
- G. Sleeve: Metal fabrication or pipe section extending through thickness of barrier and used to permanently guard penetration. Sleeves are described as part of penetrating system in other Sections and may or may not be required.
- H. Manufacturer's Engineering Judgements: Firestopping systems which are derived from other U.L. Systems/Designs or other tests, and acceptable to the code enforcing authorities.

1.4 SYSTEM DESCRIPTION

- A. Fire Rated Construction Design Requirements: Maintain barrier fire resistance ratings including resistance to cold smoke at all penetrations, connections with other surfaces or types of construction, at separations required to permit building movement and sound or vibration absorption, and at other construction gaps.
- B. Through-Penetration Fire Stopping Schedule: Assembly designs are specified generally under UL system categories by penetrating item. Manufacturers' product applications must have specific UL system designations. The schedules on the following page indicate which Series of UL Classified Through Penetration Fire Stopping (TPFS) assemblies are acceptable for this Project based on barrier type, construction and penetrant type. The TPFS Series listed are generic in nature; ex: Series C-AJ-2000 includes all designs from 2001 through 2999 from all manufacturers; note that each manufacturer has its own number for tested assemblies. The Contractor will select appropriate TPFS assemblies for each condition encountered.
- C. Refer to Schedule at the end of this section.

1.5 SUBMITTALS

- A. Product Data: Manufacturer's specifications and technical data for each material including the following.
 - 1. Composition and limitations.
 - 2. Manufacturer's installation instructions.
 - 3. Furnish sleeve size schedule indicating size of penetrating item, insulation thickness (where applicable), and minimum annular space requirements.
- B. Proposed UL System Drawings - Special Installation Drawings: Prior to starting installation of firestopping, firestopping manufacturer and installer shall review specific conditions applicable for Project, and identify each condition for firestopping and prepare individual U.L. Designs or manufacturers engineering judgements identification numbers, and installation drawings for each condition.
 - 1. Submit 3 Special Installation Drawings for each condition, 1 set for Owner, 1 set for Architect's File Copy, and 1 set for Building Official.
 - 2. Submit other information as may be requested by Building Official.
- C. Submit installer qualifications for each person installing firestopping systems.

1.6 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm experienced in installation or application of systems similar in complexity to those required for this Project, plus the following.
 - 1. Acceptable to or licensed by manufacturer, State or local authority where applicable.
 - 2. Not less than 2 years experience with systems.
 - 3. Successfully completed not less than 5 comparable scale projects using this system.

- B. Single Source Responsibility for Materials: Obtain firestopping materials from one manufacturer for entire project.
 - 1. This does not restrict Contractor from subcontracting installation of firestopping to multiple subcontracts, but does require all installers do use the same manufacturer throughout the Project and be licensed by that manufacturer for the installation of firestopping.
- C. Field Samples: First two applications for each firestopping condition will be reviewed by Owner's Representative and the Architect, and when accepted by the local Building Official shall become a standard of performance for remaining Work.
 - 1. Correct areas, modify method of application/installation, or adjust as directed by local code official to comply with specified requirements.
 - 2. Maintain field samples accessible to serve as a standard of quality for this Section.
- D. Fire-Test Response Characteristics: Provide through-penetration firestop systems that comply with the following requirements and those of this specification Section:
 - 1. Firestopping tests are performed by a qualified testing and inspecting agency. A qualified testing and inspecting agency is UL, ITS, or another agency performing testing and follow-up inspection services for firestop systems acceptable to authorities having jurisdiction.
 - 2. Through-penetration firestop systems are identical to those tested per ASTM E 814. Provide rated systems complying with the following requirements:
 - a. Through-penetration firestop system products bear classification marking of qualified testing and inspecting agency.
 - b. Through-penetration firestop systems correspond to those indicated by reference to through-penetration firestop system designations listed by the following:
 - 1) UL in "Fire Resistance Directory."
 - 2) ITS in "Directory of Listed Products."

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver, store and handle to prevent damage, staining and disfigurement in original, new, and unopened packages and containers bearing manufacturer's name and label identifying contents. Do not freeze.
- B. Where limited shelf life of product is noted by date on container or packing list, take note and do not use out of date material.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Store firestopping materials out of weather, in cool, dry place, out of direct sunlight, at temperatures below 90 degrees F, not less than 40 degrees F and as recommended by manufacturer.
- B. Use of Foam Products: Store unmixed liquid components in original, unopened containers at temperature of 65 to 80 degrees F for 12 hours minimum before use. Use forced air ventilation in areas having less than 2 cubic feet of free air for each pound of liquid mixture being foamed.

1.9 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with fireproofing material manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of fireproofing.
- B. Ventilation Requirements: Comply with fireproofing material manufacturer's recommendations during and after installation of fireproofing by natural or mechanical means.
- C. Sleeves: Unless otherwise called for, sleeves passing through walls, slabs, beams, bridging, columns, shall be minimum of 1/2 inch greater in inside diameter than external diameter of pipe passing through sleeves, or insulation diameter. Verify sleeve size required with manufacturer of firestopping used. Pipe insulation shall be continuous through sleeves. Space between sleeve and pipe or duct and annular opening space shall be provided with a firestop system. Notify Contractor immediately of deviation from above sleeving requirements.
- D. Fire Dampers: Firestopping of annular spaces around fire dampers shall be placed before installation of damper's anchoring flanges.

1.10 SEQUENCING

- A. Sequence and coordinate application of firestopping with other related work specified in other Sections to comply with the following requirements:
 - 1. Provide temporary enclosures to prevent deterioration of firestopping for interior applications due to exposure to unfavorable environmental conditions.
 - 2. Do not install enclosing or concealing construction until after firestopping has been applied, inspected, tested, and corrections have been made to any defective firestopping.

1.11 SYSTEM DESIGN

- A. Design of firestopping described by this Section is responsibility of Contractor. Individual through-penetration systems, construction-gap firestopping, through-penetration smoke-stopping, and construction-gap smoke-stopping will be selected by Contractor to meet requirements of Contract Documents and governing codes. Actual selection of individual designs or systems is responsibility of Contractor, and 'Single Source Responsibility for Materials' is required.

PART 2 PRODUCTS

2.1 THROUGH-PENETRATION FIRESTOPPING OF FIRE RATED CONSTRUCTION (FSTOP)

- A. Systems or devices listed in the UL Fire Resistance Directory under categories XHCR and XHEZ may be used, providing that they conform to the construction type, penetrant type, annular space requirements, and fire rating involved in each separate instance, and that the system be symmetrical for wall applications. Systems or devices must be asbestos-free.
 - 1. Additional requirements: Withstand the passage of cold smoke either as an inherent property of the product, or by the use of a separate product included as a part of the UL system or device, and designed to perform this function.

2.2 FIRESTOPPING, GENERAL

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

2.3 FILL MATERIALS

- A. General: Provide through-penetration firestop systems containing the types of fill materials indicated in the Through-Penetration Firestop System Schedule at the end of Part 3 by reference to the types of materials described in this Article. Fill materials are those referred to in directories of the referenced testing and inspecting agencies as fill, void, or cavity materials.

- B. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer metallic sleeve lined with an intumescent strip, a radial extended flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.
- C. Latex Sealants: Single-component latex formulations that after cure do not re-emulsify during exposure to moisture.
- D. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.
- E. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced elastomeric sheet bonded to galvanized steel sheet.
- F. Intumescent Putties: Nonhardening dielectric, water-resistant putties containing no solvents, inorganic fibers, or silicone compounds.
- G. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.
- H. Mortars: Prepackaged, dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers, and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.
- I. Pillows/Bags: Reusable, heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents and fire-retardant additives.
- J. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.
- K. Silicone Sealants: Moisture-curing, single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below:
 - 1. Grade for Horizontal Surfaces: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces.
 - 2. Grade for Vertical Surfaces: Nonsag formulation for openings in vertical and other surfaces.
- L. Wiring devices: Ez-Path Fire Rated Pathway by Specified Technologies, Inc.
 - 1. Fire-rated wiring devices containing intumescent material that allows cable to pass through device and adjusts automatically to cable additions or removals.
 - 2. F Rating: Equal to rating of barrier in which device is installed.
 - 3. Capable of allowing a 0 to 100-percent visual fill of cables.
 - 4. Sufficient size to accommodate quantity and size of electrical wires and data cables required.
 - 5. Provide with steel wall plates allowing for single or multiple devices to be ganged together.

2.4 MIXING

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

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Surface Cleaning: Clean out openings immediately before installing through-penetration firestop systems to comply with written recommendations of firestop system manufacturer and the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
 4. Do not allow caulks containing solvents to come in direct contact with plastic pipe.
- B. Priming: Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 THROUGH-PENETRATION FIRESTOP SYSTEM INSTALLATION

- A. General: Install through-penetration firestop systems to comply with "Performance Requirements" Article and firestop system manufacturer's written installation instructions and published drawings for products and applications indicated.
- B. Install forming/damming/backing materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings indicated.
1. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
- C. Install fill materials for firestop systems by proven techniques to produce the following results:
1. Fill voids and cavities formed by openings, forming materials, accessories, and penetrating items as required to achieve fire-resistance ratings indicated.
 2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
 3. For fill materials that will remain exposed after completing Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 INSTALLATION

- A. Use methods and materials indicated in firestopping systems shown in Referenced Standards.
- B. Install penetration seal materials in accordance with instructions in UL Building Materials Directory and in accordance with manufacturer's printed instructions.
- C. Install sealant, including forming, packing and other accessory materials to fill opening around services penetrating floors and walls to provide firestops with fire resistance ratings indicated for floor or wall assembly in which penetration occurs.
1. Use masking tape to protect finished substrates and products adjacent to sealant materials.
 2. Apply sealant as specified under Section 079200 - Joint Protection, and as recommended by sealant manufacturer; apply bead to depth of 1-1/2 inches to fill void above support, or if mineral wool support is used to depth of 1/2 inch thick. Tool sealant immediately after application and before skin forms.
 3. If using foam sealant, immediately after mixing, pour or inject liquid foam into penetration opening, not more than 1/3 full to compensate for expansion during cure or in strict accordance with sealant manufacturer's recommendations. Do not exceed measured snap time of foam sealant. Do not remove dams for 24 hours minimum to allow foam to fully cure.
- D. At sleeved pipes or other sleeved penetration, firestop annular space between sleeve and its contained pipe or duct with resilient firestopping sealant system to permit movement of pipe or duct without damage to firestopping sealant.
- E. Seal holes and voids made by penetrations to ensure effective fire and smoke barrier.
- F. Patch penetrations caused by cutting or presence of unused or abandoned openings or boxes using materials compatible with barrier construction and with fire rating equal to or greater than barrier rating.
- G. For plumbing sleeves, construct time rated walls after placement of penetrating materials if possible, and to fit rated construction materials tightly to or directly upon material of penetration.

- H. Large Openings: Close unused portions of large openings (annular spaces) made for later installation of pipes and ducts with solid fill equal to barrier rating or with applicable firestopping sealant system.
 - 1. Where both horizontal dimensions exceed 4 inches in structural floor openings, firestop annular spaces with concrete, or other rated assembly. Provide dowels and reinforcement, within such fill, equal to that specified for slab.
 - 2. In rated concrete or masonry wall openings where both height and width exceed thickness of rated materials, firestop annular spaces with masonry or other solid fill.
 - 3. Use fiber fill, solid fill or fiber packing to make up remainder of barrier thickness where required width of firestopping sealant system is less than barrier.
- I. Install firestopping materials capable of supporting same loading as floor at floor openings more than four inches in width without penetrating item and subject to traffic or loading.
- J. Install firestopping at least equal to barrier fire rating in and around penetrations of floor structures, exterior walls and interior walls noted as time rated fire barriers or smoke barriers.
- K. Unused or abandoned openings or boxes or penetrations caused by cutting shall be patched with materials compatible with barrier construction and with fire rating equal to or greater than barrier fire-rating.
- L. Use firestopping sealant systems at narrow spaces and at spaces with dimensions less than barrier thickness.
- M. Fill void spaces completely with firestopping material.
- N. Protect materials from damage on surfaces subject to traffic. Provide firestopping in floors flush with top of slab, sleeve or housekeeping pad.

3.5 IDENTIFICATION

- A. Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:

<p>Warning – Fire-stop System DO NOT DISTURB Notify Building Management of Any Damage</p> <p>Manufacturer's System No. _____ UL System No: _____ Contractor: _____ Date Installed: _____ Manufacturer: _____</p>

3.6 FIELD QUALITY CONTROL

- A. Inspecting Agency: Owner will engage a qualified independent inspecting agency to inspect through-penetration firestop systems and to prepare test reports.
 - 1. Inspecting agency will state in each report whether inspected through-penetration firestop systems comply with or deviate from requirements.
- B. Proceed with enclosing through-penetration firestop systems with other construction only after inspection reports are issued.
- C. Where deficiencies are found, repair or replace through-penetration firestop systems so they comply with requirements.

- D. Manufacturer's Field Services: Firestopping manufacturer's technical representative shall provide the following field services during application.
1. Perform a pre-installation examination and acceptance of substrate and voids scheduled for firestopping. Issue report.
 2. Be present at initial start-up for each process. Confirm application techniques. Issue report.
 3. Issue a summary report at completion of installation indicating manufacturer's acceptance of installed system and compliance with UL Design requirements.

3.7 ADJUSTING AND CLEANING

- A. Clean up spills of liquid components.
- B. Neatly cut and trim materials.
- C. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.8 SCHEDULE

- A. See attached pages for schedule of firestopping systems

Firestopping Wall Systems

TYPE OF PENETRANT	WOOD STUDS & GYPSUM WALLBOARD UL DESIGN NO. U300 SERIES	METAL STUDS & GYPSUM WALLBOARD UL DESIGN NO. U400 SERIES	POURED CONCRETE, CONCRETE BLOCK OR MASONRY UL DESIGN NO. FOR CONCRETE BLOCK WALL U900 SERIES (ANY THICKNESS)	POURED CONCRETE CONCRETE BLOCK OR MASONRY UL DESIGN NO. FOR CONCRETE BLOCK WALL U900 SERIES GREATER THAN 8 IN.
NO PENETRANTS				
UL System Single penetrant	W-L-0000 SERIES OR NOTE 4	W-L-0000 SERIES OR NOTE 4	W-J-0000 SERIES OR NOTE 4	NOTE 4
UL System Multiple penetrants	W-L-0000 SERIES OR NOTE 4	W-L-0000 SERIES OR NOTE 4	W-J-0000 SERIES OR NOTE 4	NOTE 4
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
METALLIC, UNINSULATED PIPE, CONDUIT, OR TUBING (EXAMPLES: COPPER, IRON, STEEL)				
UL System Single penetrant	W-L-1000 SERIES	W-L-1000 SERIES	C-AJ-1000 OR W-J- 1000 SERIES	C-BK-1000 OR W-K- 1000 SERIES
UL System Multiple penetrants	W-L-8000 SERIES NOTE 5	W-L-8000 SERIES NOTE 5	C-AJ-8000 OR W-J- 8000 SERIES -- NOTE 5	N/A
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
NONMETALLIC, UNINSULATED PIPE, CONDUIT, OR TUBING (EXAMPLES: PVC, CPVC, GLASS)				
UL System Single penetrant	W-L-2000 SERIES	W-L-2000 SERIES	C-AJ-2000 OR W-J- 2000 SERIES	C-BK-1000 OR W-K- 1000 SERIES
UL System Multiple penetrants	W-L-8000 SERIES NOTE 5	W-L-8000 SERIES NOTE 5	C-AJ-8000 OR W-J-8000 SERIES -- NOTE 5	N/A
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
ELECTRICAL CABLES				
UL System Single penetrant	W-L-3000 SERIES	W-L-3000 SERIES	C-AJ-3000 OR W-J- 3000 SERIES	N/A
UL System Multiple penetrants	NONE	NONE	C-AJ-3000 OR W-J- 3000 SERIES	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
CABLE TRAYS W/ELECTRICAL CABLES				
UL System	W-L-4000 SERIES	W-L-4000 SERIES	C-AJ-4000 OR W-J-	W-K-4000 SERIES

TYPE OF PENETRANT	WOOD STUDS & GYPSUM WALLBOARD UL DESIGN NO. U300 SERIES	METAL STUDS & GYPSUM WALLBOARD UL DESIGN NO. U400 SERIES	POURED CONCRETE, CONCRETE BLOCK OR MASONRY UL DESIGN NO. FOR CONCRETE BLOCK WALL U900 SERIES (ANY THICKNESS)	POURED CONCRETE CONCRETE BLOCK OR MASONRY UL DESIGN NO. FOR CONCRETE BLOCK WALL U900 SERIES GREATER THAN 8 IN.
Single penetrant			4000 SERIES	
UL System Multiple penetrants	NONE	NONE	C-AJ-4000 OR W-J- 4000 SERIES	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
INSULATED PIPES (EXAMPLES: COPPER, GLASS, IRON, PLASTIC, STEEL) IN SYSTEMS OPERATING BETWEEN 32 DEGF (0 DEGC) AND 122 DEGF (50 DEGC) (NOTE 1)				
UL System Single penetrant	W-L-5000 SERIES	W-L-5000 SERIES	C-AJ-5000 OR W-J- 5000 SERIES	N/A
UL System Multiple penetrants	W-L-8000 SERIES NOTE 5	W-L-8000 SERIES NOTE 5	C-AJ-8000 OR W-J- 8000 SERIES - NOTE 5	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
INSULATED PIPES (EXAMPLES: COPPER, GLASS, IRON, PLASTIC, STEEL) IN SYSTEMS OPERATING BELOW 32 DEGF (0 DEGC) OR ABOVE 122 DEGF (50 DEGC) (NOTE 2)				
UL System Single penetrant	W-L-5000 SERIES	W-L-5000 SERIES	C-AJ-5000 OR W-J- 5000 SERIES	N/A
UL System Multiple penetrants	W-L-8000 SERIES NOTE 5	W-L-8000 SERIES NOTE 5	C-AJ-5000 OR W-J- 5000 SERIES	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NOTE 6	NOTE 6	NOTE 6	NONE
MISC ELECTRICAL PENETRATIONS (EXAMPLES: BUS DUCTS)				
UL System Single penetrant	W-L-6000 SERIES	W-L-6000 SERIES	C-AJ-6000 SERIES	N/A
UL System Multiple penetrants	N/A	N/A	C-AJ-6000 SERIES	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING	EQUAL TO F RATING	EQUAL TO F RATING	EQUAL TO F RATING

TYPE OF PENETRANT	WOOD STUDS & GYPSUM WALLBOARD UL DESIGN NO. U300 SERIES	METAL STUDS & GYPSUM WALLBOARD UL DESIGN NO. U400 SERIES	POURED CONCRETE, CONCRETE BLOCK OR MASONRY UL DESIGN NO. FOR CONCRETE BLOCK WALL U900 SERIES (ANY THICKNESS)	POURED CONCRETE CONCRETE BLOCK OR MASONRY UL DESIGN NO. FOR CONCRETE BLOCK WALL U900 SERIES GREATER THAN 8 IN.
	(NOTE 9)	(NOTE 9)	(NOTE 9)	(NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
METAL DUCT				
UL System Single penetrant	W-L-7000 SERIES	W-L-7000 SERIES	C-AJ-7000 OR W-J-7000 SERIES	N/A
UL System Multiple penetrants	N/A	N/A	N/A	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NOTE 7	NOTE 7	NOTE 7	NONE
UL LISTED ELECTRICAL BOXES				
UL System Single penetrant	CLIV OR NOTE 8	CLIV OR NOTE 8	N/A	N/A
UL System Multiple penetrants	N/A	N/A	N/A	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE
OTHER RECESSED DEVICES (NOTE 3)				
UL System Single penetrant	NOTE 8	NOTE 8	NOTE 8	NOTE 8
UL System Multiple penetrants	NONE	NONE	NOTE 8	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE	NONE

Floor Systems

TYPE OF PENETRANT	WOOD FRAMED FLOOR	POURED CONCRETE FLOOR ANY THICKNESS	POURED CONCRETE FLOOR GREATER THAN 5 INCHES
NO PENETRANTS			
UL System Single penetrant	W-L-000 SERIES OR NOTE 4	C-AJ-0000 SERIES, F-A-0000 SERIES OR NOTE 4	C-BJ-0000 SERIES OR NOTE 4
UL System Multiple penetrants	W-L-000 SERIES OR NOTE 4	NONE	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE

TYPE OF PENETRANT	WOOD FRAMED FLOOR	POURED CONCRETE FLOOR ANY THICKNESS	POURED CONCRETE FLOOR GREATER THAN 5 INCHES
METALLIC, UNINSULATED PIPE, CONDUIT, OR TUBING (EXAMPLES: COPPER, IRON, STEEL)			
UL System Single penetrant	F-C-1000 SERIES	C-AJ-1000 OR F-A-1000 SERIES	C-BJ-1000 OR F-B-1000 SERIES
UL System Multiple penetrants	F-C-8000 SERIES NOTE 5	C-AJ-8000 OR F-A-8000 SERIES -- NOTE 5	C-BJ-8000 OR F-B-8000 SERIES -- NOTE 5
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE
NONMETALLIC, UNINSULATED PIPE, CONDUIT, OR TUBING (EXAMPLES: PVC, CPVC, GLASS)			
UL System Single penetrant	F-C-2000 SERIES	C-AJ-2000 OR F-A-2000 SERIES	C-BJ-2000 OR F-B-2000 SERIES
UL System Multiple penetrants	NONE	C-AJ-8000 OR F-A-8000 SERIES -- NOTE 5	C-BJ-8000 OR F-B-8000 SERIES -- NOTE 5
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE
ELECTRICAL CABLES			
UL System Single penetrant	F-C-3000 SERIES	C-AJ-3000 OR F-A-3000 SERIES	N/A
UL System Multiple penetrants	NONE	NONE	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE
CABLE TRAYS W/ELECTRICAL CABLES			
UL System Single penetrant	N/A	C-AJ-4000 OR F-A-4000 SERIES	C-BJ-3000 OR F-B-3000 SERIES
UL System Multiple penetrants	NONE	NONE	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE
INSULATED PIPES (EXAMPLES: COPPER, GLASS, IRON, PLASTIC, STEEL) IN SYSTEMS OPERATING BETWEEN 32 DEGF (0 DEGC) AND 122 DEGF (50 DEGC) (NOTE 1)			
UL System Single penetrant	F-C-5000 SERIES	C-AJ-5000 OR F-A-5000 SERIES	C-BJ-5000 OR F-B-5000 SERIES
UL System Multiple penetrants	F-C-8000 SERIES NOTE 5	C-AJ-8000 OR F-A-8000 SERIES - NOTE 5	C-AJ-8000 OR F-A-8000 SERIES - NOTE 5
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)

TYPE OF PENETRANT	WOOD FRAMED FLOOR	POURED CONCRETE FLOOR ANY THICKNESS	POURED CONCRETE FLOOR GREATER THAN 5 INCHES
Additional Requirements	NONE	NONE	NONE
INSULATED PIPES (EXAMPLES: COPPER, GLASS, IRON, PLASTIC, STEEL) IN SYSTEMS OPERATING BETWEEN 32 DEGF (0 DEGC) OR ABOVE 122 DEGF (50 DEGC) (NOTE 2)			
UL System Single penetrant	F-C-5000 SERIES	C-AJ-5000 OR F-A-5000 SERIES	C-AJ-5000 OR F-A-5000 SERIES
UL System Multiple penetrants	F-C-8000 SERIES NOTE 5	C-AJ-8000 OR F-A-8000 SERIES - NOTE 5	C-BJ-8000 OR F-B-8000 SERIES - NOTE 5
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NOTE 6	NOTE 6	NOTE 6
MISC ELECTRICAL PENETRATIONS (EXAMPLES: BUS DUCTS)			
UL System Single penetrant	N/A	C-AJ-6000 SERIES	C-AJ-6000 SERIES
UL System Multiple penetrants	NONE	C-AJ-8000 OR F-A-8000 SERIES - NOTE 5	C-AJ-6000 SERIES
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE
METAL DUCT			
UL System Single penetrant	F-C-7000 SERIES	C-AJ-7000 OR F-A-7000 SERIES	C-BJ-7000 OR F-B-7000 SERIES
UL System Multiple penetrants	N/A	N/A	N/A
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NOTE 7	NOTE 7	NOTE 7
UL LISTED ELECTRICAL BOXES			
UL System Single penetrant	N/A	N/A	N/A
UL System Multiple penetrants	N/A	N/A	N/A
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE
OTHER RECESSED DEVICES (NOTE 3)			
UL System Single penetrant	NOTE 8	NOTE 8	NOTE 8
UL System Multiple penetrants	NONE	NONE	NONE
F Rating	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING	EQUAL TO BARRIER RATING
T Rating	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)	EQUAL TO F RATING (NOTE 9)
Additional Requirements	NONE	NONE	NONE

THIS SCHEDULE USES THE IDENTIFICATION SYSTEMS OF UNDERWRITERS LABORATORIES, INC. AS DEFINED IN THEIR "FIRE RESISTANCE DIRECTORY" AND AS USED BY MANUFACTURERS ON THEIR UL CLASSIFIED SYSTEM. INDICATED RATINGS MAY BE EXCEEDED. "N/A" = NOT APPLICABLE

NOTES

1. EXAMPLES OF SYSTEMS THAT OPERATE BETWEEN 32 DEG F (0 DEG C) AND 122 DEG F (50 DEG C):
 - CHILLED WATER SUPPLY & RETURN
 - DOMESTIC HOT WATER LESS THAN 122 DEG F (50 DEG C)
 - HEAT PUMP WATER SUPPLY & RETURN
 - DOMESTIC HOT WATER RECIRCULATION LESS THAN 122 DEG F (50 DEG C)
 - DOMESTIC COLD WATER
2. EXAMPLES OF SYSTEMS OPERATING BELOW 32 DEG F (0 DEG C) OR ABOVE 122 DEG F (50 DEG C):
 - STEAM SUPPLY & RETURN
 - HEATING HOT WATER SUPPLY & RETURN
 - STEAM VENT
 - HOT-CHILLED WATER SUPPLY & RETURN
 - CONDENSATE PUMP DISCHARGE
 - GLYCOL HEATING HOT WATER SUPPLY & RETURN
 - BOILER BLOW DOWN
 - DOMESTIC HOT WATER SUPPLY 140 DEG F (60 DEG C)
 - CRYOGENIC VENT
 - DOMESTIC HOT WATER RECIRCULATION 140 DEG F (60 DEG C)
3. EXAMPLES OF OTHER RECESSED DEVICES:
 - MEDICAL GAS ZONE VALVES
 - UNIT HEATERS
 - MEDICAL GAS OUTLETS
 - FIRE FIGHTERS' PHONE
 - FIRE VALVE CABINETS
 - FIRE EXTINGUISHER CABINET
 - FIRE HOSE CABINETS
4. SEAL OPENING USING BARRIER'S ORIGINAL CONSTRUCTION.
5. WHERE A SERIES 8000 CLASSIFIED SYSTEM IS NOT AVAILABLE, INSTALL PENETRANTS SINGLY, AND PROVIDE SINGLE-PENETRANT SYSTEMS.
6. FOR SYSTEMS THAT OPERATE BELOW 32 DEG F (0 DEG C) OR ABOVE 122 DEG F (50 DEG C), COMPLY WITH THE FOLLOWING ADDITIONAL REQUIREMENTS:
 - A. PROVIDE TPFS SYSTEM USING INTUMESCENT ELASTOMERIC WRAP STRIP AS ITS FILL, VOID, OR CAVITY MATERIAL.
 - B. DO NOT USE SERIES 8000 PENETRATIONS. PROVIDE ONLY SINGLE PENETRATIONS.
7. FOR PENETRATIONS PROTECTED WITH DAMPERS, PROVIDE TPFS SYSTEM APPROVED BY DAMPER MANUFACTURER.
WHERE UL CLASSIFIED SYSTEMS ARE NOT AVAILABLE FOR OTHER RECESSED DEVICES, MAINTAIN CONTINUITY OF RATED BARRIER CONSTRUCTION AROUND RECESS.
9. WHERE PENETRANT EXITS PENETRATION ENTIRELY WITHIN A FLOOR, PROVIDE FIRESTOP SYSTEM WITH THE SAME LEVEL OF FIRE RESISTANCE AS THE FLOOR SYSTEM. ONE SIDED COMPOSITE PANEL SYSTEMS ARE NOT ALLOWED.

END OF SECTION

SECTION 079000 JOINT PROTECTION

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Exterior and interior sealants.
 - 2. Foam gasket seals.
 - 3. Compressible seals.
- B. Related Sections:
 - 1. Section 033000 – Cast-in-Place Concrete: Sealant in conjunction with exterior horizontal concrete joints.
 - 2. Section 076210 - Sheet Metal Flashing and Trim: Sealant concealed within sheet metal.
 - 3. Section 084400 – Aluminum Curtain Walls, Windows and Entrances: Sealant at modified entrance system.
 - 4. Section 088000 - Glazing: Glazing sealant.
 - 5. Section 092900 - Gypsum Board: Acoustical sealant at gypsum board systems.
 - 6. Section 093000 - Tiling: Sealant in tile work.
 - 7. Section 078400 – Firestopping.
 - 8. Section 078443 – Fire-Resistant Joint Sealants.
 - 9. Section 321320 – Site Concrete: Sealant in conjunction with concrete joints in curbs.

1.2 SUBMITTALS

- A. Comply with Section 013300, unless otherwise indicated.
- B. Product Data: Manufacturer's specifications and technical data including performance, construction and fabrication.
 - 1. Manufacturer's installation instructions for specific substrates on surface preparation and application for each type of sealant specified.
 - 2. Indicate joint dimensions and description of sealant.
- C. Color Samples: 2 sets of manufacturer's full color range for each type of sealant specified.
- D. Quality Control: Comply with Section 014500.
 - 1. Statement of qualification for manufacturers and installers.
 - 2. Statement of compliance for compatibility of sealant with adjacent materials and coatings.
 - 3. Field Quality Control submittals as specified in Part 3 of this Section.
 - a. Field adhesion tests.
 - b. Manufacturer's Field Services: For sizing of foam gasket seals and compressible seals.

1.3 QUALITY ASSURANCE

- A. Installer Qualifications: Engage experienced Installer who has completed joint sealant applications similar in material, design, and extent to that indicated for Project that have resulted in construction with record of successful in-service performance.
- B. Provide materials for exterior envelope from a single manufacturer.
- C. Compatibility: Verify compatibility of silicone sealant with materials in contact with sealant.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time and mixing instructions for multi component materials.
- B. Store and handle materials to prevent their deterioration or damage due to moisture, temperature changes, contaminants, or other causes.

1.5 PROJECT CONDITIONS

- A. Weather Conditions: Do not proceed with installation of sealant under adverse weather conditions, or when temperatures are below or above manufacturer's recommended limitations for installation.
 - 1. Proceed with work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength.
 - 2. Wherever joint width is affected by ambient temperature variation, apply elastomeric sealant only when temperatures are in lower third of manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures.
- B. Joint Width Conditions: Do not proceed with installation of joint sealers when joint widths are less than allowed by joint sealer manufacturer for application indicated.
- C. Joint Substrate Conditions: Do not proceed with installation of joint sealers until contaminants capable of interfering with their adhesion are removed from joint substrates.
- D. Compatibility and Adhesion Testing: Ascertain sealant compatibility and adhesion with adjacent materials using laboratory testing procedures.

PART 2 PRODUCTS

2.1 SEALANT MATERIALS

- A. 1-Part Polyurethane Sealants: Polyurethane based one part elastomeric sealant, complying with FS- TT-S-00230C, Type II Class A, with elongation and compression of not less than 25 percent. ASTM C920, Type S, Class 25, Grade NS.
- B. 2-Part Polyurethane Sealant for Horizontal Applications: Self-leveling polyurethane based 2 part elastomeric sealant, complying with FS-TT-S-00227E, Type I, Class A, with shore A hardness of not less than 30 and elongation and compression of not less than 25 percent. ASTM C920, Type M, Class 25, Grade P.
- C. Low-Modulus Silicone Rubber Sealant: Silicone rubber based, one part neutral cure elastomeric sealant with plus 50 percent to minus 50 percent movement complying with FS-TT-S-001543, Class A, and recommended by manufacturer for joints.
- D. Ultra Low-Modulus Silicone Rubber Sealant: Silicone rubber based, one part neutral cure elastomeric sealant with plus 100 percent to minus 50 percent movement complying with FS-TT-S-001543, Class A.
- E. Mildew-Resistant Silicone Rubber Sealant: Silicone rubber based, one part mildew resistance sealant with integral fungicide complying with FS-TT-S-001543A, Class A. Specifically recommended by manufacturer for interior joints in wet areas around plumbing fixtures and ceramic tile.
- F. Acrylic Sealants: General purpose, paintable acrylic-emulsion sealant. Caulk with approximately 12- 1/2 percent elongation complying with ASTM C834.
- G. Colors: Colors as selected by Architect from manufacturer's standard colors. Acceptance of sealant will depend on range of standard colors available for selection.

2.2 FOAM GASKET SEAL

- A. Joint Design: Joint manufacturer shall review layout, configuration, and anticipated movement and establish the specific model number and size of Foam Gasket Sealant for this application.
- B. (FGS-1) Foam Gasket Seal: Pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. and impregnated with a nondrying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
- C. Splice Adhesive for Foam Gasket Seal: One part urethane wet sealant as recommended by gasket seal manufacturer.

2.3 JOINT SEALANT BACKING

- A. General: Provide sealant backings of material that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
- B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
 - 1. Provide Type C closed-cell backings at horizontal applications and at acoustically-rated assemblies.
 - 2. Use of Type O open-cell backing is acceptable only as approved by Architect for joints meeting the following conditions:
 - a. Closed-cell backing cannot accommodate joint movement;
 - b. Joint is not exposed to moisture;
 - c. Joint is not horizontal;
 - d. Joint is not in an acoustically-rated assembly.
- C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.4 ACCESSORIES

- A. Joint Primer: Non-staining type recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive type recommended by sealant manufacturer; compatible with joint forming materials.
- C. Bond Breaker: ASTM C962, pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine joint surfaces, backing, and anchorage of units forming sealant rabbet, and conditions under which sealant work is to be performed. Do not proceed with sealant work until unsatisfactory conditions have been corrected.

3.2 JOINT SURFACE PREPARATION

- A. Clean joint surfaces immediately before installation of sealant. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant.
- B. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5 percent solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant application.
- C. Roughen joint surfaces on vitreous coated and similar non-porous materials, wherever sealant manufacturer's data indicates lower bond strength than for porous surfaces. Rub with fine abrasive cloth or steel wool to produce dull sheen.
- D. Ensure that joint forming materials are compatible with sealant.
- E. Examine joint dimensions and size materials to achieve required width/depth ratios. Use joint filler to achieve required joint depths, to allow sealants to perform properly.

3.3 SEALANT APPLICATION

- A. Apply sealant in accordance with manufacturer's printed instructions. Perform work in accordance with ASTM C1193.

- B. Prime or seal joint surfaces. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.
- C. Install sealant backer rod for liquid elastomeric sealant, except where recommended to be omitted by sealant manufacturer for application shown.
- D. Install bond breaker tape wherever required by manufacturer's recommendations to ensure that elastomeric sealant will perform properly.
- E. Employ only proven installation techniques, which will ensure that sealant will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides.
 - 1. Except as otherwise indicated, fill sealant rabbet to slightly concave surface, slightly below adjoining surfaces. Where horizontal joints are between horizontal surface and vertical surface, fill joint to form slight cove, so that joint will not trap moisture and dirt.
- F. Install sealant to depth as shown or, if not shown, as recommended by sealant manufacturer but within following general limitations, measured at center (thin) section of bead:
 - 1. For sidewalks, pavements and similar joints sealed with elastomeric sealant and subject to traffic and other abrasion and indentation exposures, fill joints to depth equal to 75 percent of joint width, but not more than 5/8 inch deep nor less than 3/8 inch deep.
 - 2. For normal moving joints sealed with elastomeric sealant, but not subject to traffic, fill joint to depth equal to 50 percent of joint width, but not more than 1/2 inch deep nor less than 1/4 inch deep.
- G. Interior joints not subject to movement, these are:
 - 1. Gypsum board to masonry joints.
 - 2. Gypsum board to hollow metal joints.
 - 3. Gypsum board to concrete joints.
- H. Do not allow sealant or compounds to overflow or flow onto adjoining surfaces, or to migrate into voids of adjoining surfaces including rough texture surfaces. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces, by either primer/sealer or sealant.
- I. Remove excess and spillage of sealant promptly as work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage, without damage to adjoining surfaces or finishes.
- J. Rope Wicks: Where wicks for weeping masonry cavity occur in sealant, cut wick flush with sealant face and do not seal wick ends.

3.4 FOAM GASKET SEAL INSTALLATION

- A. Comply with manufacturer's recommendations except where more stringent requirements are specified, or except where manufacturer's technical representative directs otherwise.
- B. Clean, prepare, and size joints to comply with manufacturer's recommendations. Remove loose materials and other foreign matter which might impair adhesion of sealant.
 - 1. Size material to obtain compression of 25 percent of uncompressed dimension.
- C. Remove foam gasket from protective wrapping.
- D. Expose self-adhesive side and secure against joint face.
- E. Horizontal Joints: Proceed sequentially in one direction with scarfed ends pushed well past one another.
- F. Vertical Joints: Start at bottom and proceed up wall.
- G. Do not stretch material during installation.

3.5 FIELD QUALITY CONTROL

- A. Sealant Adhesion Field Test: Comply with following.
 - 1. Weathering Sealant Adhesion: After liquid-applied sealant is fully cured, perform sealant adhesion test according to sealant manufacturer's recommendations.

3.6 PROTECTION AND CLEANING

- A. Protect joint sealers during and after curing period from contact with contaminating operations or other causes so that they are without deterioration or damage at time of Substantial Completion.
 - 1. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealers immediately and reseal joints with new materials to produce joint sealer installations with repaired areas indistinguishable from original work.
- B. Clean off excess sealant or sealant smears adjacent to joints as work progresses by methods and with cleaning materials approved by manufacturers of joint sealers and of products in which joints occur.

3.7 SCHEDULE

- A. Provide sealant where indicated (SLNT) or as required to achieve a weather-tight assembly.
- B. The following schedule is not intended to be all inclusive.
 - 1. Exterior Joints at EIFS to EIFS, and Unit Masonry to Unit Masonry: Ultra low modulus silicone sealant.
 - 2. Exterior Joints at EIFS to Curtain Wall or Window System: Low modulus silicone sealant.
 - 3. Joints subject to Pedestrian or Vehicle Traffic: Use 2 part, self leveling polyurethane sealant.
 - 4. Interior Joints Subject to Movement: One part polyurethane sealant.
 - 5. Interior Joints NOT Subject to Movement: Acrylic sealant.
 - 6. Interior Joints in Ceramic Tile Walls and Floors, and around Equipment and Plumbing Fixtures: Mildew resistant silicone rubber sealant.

END OF SECTION

SECTION 081113 HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Pressed steel hollow metal doors and frames.
 - 2. Fire-rated hollow metal doors and frames.
 - 3. Hollow metal window-walls, glazed openings, and other hollow metal frames for glass.
 - 4. Rough bucks, frame reinforcing, door reinforcing, door insulation, closure panels, clip angles and anchorage.
 - 5. Factory prime paint finish.
- B. Related Sections:
 - 1. Section 083100 - Access Doors and Panels.
 - 2. Section 087100 – Door Hardware: Finish hardware, weather-stripping and sound-stripping.
 - 3. Section 088000 - Glazing: Glass and glazing.
 - 4. Section 099000 – Painting: Finish painting.

1.2 REFERENCES

- A. ANSI/SDI-100-83 - Recommended Specifications - Standard Steel Doors and Frames, Steel Door Institute, unless herein specified.
- B. Underwriters' Laboratories Inc. (UL) UL63, Factory Mutual (FM), or Warnock Hersey as applicable to fire rated hollow metal assemblies and acceptable to authorities having jurisdiction.
- C. NFPA No. 80 - Fire Doors and Windows.
- D. ANSI A115.1-.17 - Specification for Door and Frame Preparation for Hardware.
- E. ANSI A156.7 (Supersedes CS9-65) - Standard Template Hinge Dimensions.
- F. Design Guide for the Built Environment of Behavioural Health Facilities, Edition 7.0, FGI & NAPHS

1.3 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300. Indicate general construction, configurations, jointing methods, reinforcements, and location of hardware and cutouts for glass and louvers.

1.4 QUALITY ASSURANCE

- A. Applicable Standards: Specifications and standards of SDF 100-83.
- B. Installer Qualification: Experience with installation of similar materials.
- C. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E152 "Standard Methods of Fire Tests of Door Assemblies" by nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction.
 - 1. Oversize Fire-Rated Door Assemblies: For door assemblies required to be fire-rated and exceeding sizes of tested assemblies, provide certificate or label from approved independent testing and inspection agency, indicating that door and frame assembly conforms to requirements of design, materials and construction as established by individual listings for tested assemblies.

1.5 PRODUCT HANDLING

- A. Deliver hollow metal doors in manufacturer's protective covering. Handle hollow metal with care to prevent damage.
- B. Door Storage: Store doors in upright position, under cover. Place doors on at least 4 inch wood sills or on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. If corrugated wrapper on door becomes wet, or moisture appears, remove wrapping immediately. Provide 1/4 inch space between doors to promote air circulation.
- C. Frame Storage: Store frames under cover on 4 inch wood sills on floors in manner that will prevent rust and damage. Do not use non-vented plastic or canvas shelters which create humidity chamber and promote rusting. Store assembled frames in vertical position, 5 units maximum in stack. Provide 1/4 inch space between frames to promote air circulation.

PART 2 PRODUCTS

2.1 HOLLOW METAL

- A. Acceptable Manufacturers: Trussbilt, Mesker, Pioneer, Steelcraft, Curries, Ceco, North Central Supply, Precision Metals, Republic, Kewanee, Security Metal Products.
- B. Cold Rolled Steel Sheets: Cold formed, prime quality pickled, annealed stretcher level steel, free from scale, pitting or other surface defects, complying with ASTM A366.
- C. Galvanized Steel Sheets: ASTM A526 or A527, G60 zinc coating. Use galvanized steel sheets for exterior hollow metal doors, door frames and door louvers.
- D. Minimum gages of hollow metal are specified below. Provide heavier gage if required by details or specific condition. Entire frame and sidelight shall be of same gage.
 - 1. 16 gage: Interior door frames, and glazed opening frames.
 - 2. 16 gage: Labeled frames (or heavier if required by label).
 - 3. 18 gage: Interior doors (or heavier if required by label).
 - 4. 14 gage: Exterior door frames, window-wall and window frames, transom and sidelight frames.
 - 5. 16 gage: Exterior doors.

2.2 RELATED MATERIALS

- A. Steel Reinforcing: ASTM A36.
- B. Door Bumpers or Silencers: GJ-64.

2.3 HOLLOW METAL FRAMES

- A. General: Provide frames as full profile welded unless otherwise indicated. Where necessary, alternate details will be considered provided design intent is maintained. Consider and provide for erection methods.
- B. Typical Reinforcing: Provide minimum hinge reinforcement 3/16 inch by 1-1/2 inch by 9 inch and lock strike reinforcement 3/16 inch by 1-1/2 inch by 4 inch long. Provide similar reinforcement for hardware items as required to adequately withstand stresses, minimum 12 gage, including channel reinforcement for door closers and closer arms, door holders and similar items. Provide reinforcement and clearances for concealed in-head bar closers and for mortise locks.
- C. Cover Plates: For hinge and strike plate cutouts, provide fully enclosed pressed steel cover boxes spot welded to frames behind mortises.
- D. Hardware: Mortise, reinforce, drill and tap for mortise hardware, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field.

- E. Anchorage: Provide standard and special anchorage items as required. Provide 12 gage angle clips at bottom of frames with punched holes for securing frames to floor, except where frames are secured entirely by rough bucks. Provide formed steel channel spreader at bottom of frames, removable without damaging frame. At masonry, provide anchors (about 2 inch by 10 inch) approximately 24 inches on center.
- F. Silencers: Provide specified silencers, except where stop does not occur and at smoke gasketed openings, 3 per jamb at single door and one for each door at double doors. Provide approximate match to scheduled finish color of frame from the manufacturer's full range of silencer colors.
- G. Extensions: Reinforce transom bars or mullions as necessary to provide rigid installation. Where required (as at multiple openings) to stabilize large frames, provide frame or mullion extensions to anchor to structure above, proper size to fit within overhead construction. Provide angle clips to fasten to structure.
- H. Mullions: Provide mullions, continuously reinforced, straight and without twist, of tubular design. For removable mullions provide fastenings of non-ferrous bolts at bottom, with sleeves at head of frame for mullion to clip over.
- I. Clearances: Provide and be responsible for proper clearances at metal frames, including for weatherstripping, soundstripping and smoke gasketing. Glass clearance shall be thickness of glass plus clearance each side (1/8 inch minimum exterior - 1/16 inch minimum interior), adjust for installation, glass thickness to allow for glazing and sealant. Where sealed double glazing is indicated, provide rebates minimum of 3/4 inch and provide 1/4 inch clearance at glass edges. Where units fit around concrete blocks (blocks built into frames) obtain actual dimensions of blocks being used to establish minimum clearances. Coordinate to final reviewed glazing submittals due to variable thicknesses in security glazing products.
- J. Stops: Set with countersunk or Jackson head screws.
- K. Stops: Install stops in tamper resistant fashion
 - 1. With pick resistant sealant, and gaskets & backer rods with max 8' continuous lengths or with Anti-ligature breakpoints where indicated AND
 - a. in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - b. all areas of the ARF and MHRC.
 - 2. Heavy duty, institutional grade pick resistant per referenced guidelines.
 - 3. Tamper resistant fasteners and installation methods.
- L. Labeled Frames: Construct in accordance with requirements for labeled work. Attach proper U.L. label, Warnok Hersey. "B" labeled frames shall be 1-1/2 hour construction.
- M. Joinings: At frames with equal width jambs and head, neatly miter on face (except locations as at transom bars and at frames with large head members). Cope and butt stops. Weld length of entire joint, including face and flat intersections. Grind smooth, at other frames, provide same mitered joint wherever possible (at intersection of jamb-head or jamb-sill) and at other locations butt metal neatly and fully welded. All joints to be tight, neatly ground, puttied, and sanded smooth before priming.
 - 1. Install frames with no protruding openings or of a closed type with no tie points at latch areas.
 - a. Provide Anti-ligature latch-bolt receivers where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Heavy duty, institutional grade
 - c. Tamper resistant fasteners
- N. Workmanship: Fabricate so no grind marks, hollow or other out-of-plane areas are visible. At joints of intermediate members (as mullions and transom bars), provide tight joining, neatly accomplished without holes, burned out spots, weld build up or other defacing work. Fill to close cracks and to preserve shapes. Tightly fit loose stops, to hairline joints.
- O. Finish: Clean frames by degreasing process and apply thorough coating of baked-on primer, covering inside as well as outside surfaces. At galvanized frames, coat welds and other disrupted surface with zinc-rich paint containing not less than 90 percent zinc dust by weight.

2.4 FRAME ANCHORS

- A. Jamb Anchors:
 - 1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch (1.0 mm) thick.
 - 2. Postinstalled Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch- (9.5-mm-) diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.
- B. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 - 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 - 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.

2.5 HOLLOW METAL DOORS

- A. Provide to design indicated including: Flush panel doors, flush panel with cut-out as indicated, stile and rail type, Wicket or other barrier free doors, stile and rail with door louver. Use galvanized steel at exterior doors.
- B. Flush Doors: Reinforce, stiffen and sound deaden. Provide cut-outs for glass and louvers with stops as shown. Provide flush steel closure at top of exterior and interior doors and at bottom of exterior doors with drain holes in bottom closure. Provide seamless edge. Following door construction types are acceptable.
 - 1. Exterior Doors (and Interior Reinforced Doors): Reinforced with 20 gage steel stiffeners vertically 6 inches o.c. full height and width, spot welded 5 inches o.c. to both face sheets. Stiffeners welded together top and bottom. Insulate with 2-1/2 lb density mineral wool insulation.
 - 2. Honeycomb Core Interior Doors (Typical): Impregnated Kraft honeycomb core completely filling inside of center panel and permanently laminated to inside face sheets.
 - 3. Door Construction: Manufacturer's standard honeycomb, polyurethane foamed in place, unitized steel grid, vertical steel stiffeners, or rigid mineral fiber core with internal sound deadener on inside of face sheets where appropriate in accordance with SDI standards.
- C. Stile and Rail Doors: Construct with equivalent reinforcing. Reinforce intersections of stiles and rails at stile type doors, to form rigid unit capable of withstanding severe abuse without racking or sagging.
- D. Labeled Doors: Insulate as required by Underwriters Laboratories. Build in special hardware and provide astragals as indicated. At one hour and at 1-1/2 hour doors at enclosures, maximum transmitted temperature end point shall not exceed 450 degrees F above ambient at end of 30 minutes of fire exposure specified in NFPA 252 and UL10 ABC as applicable.
- E. Seamless Vertical Edges: Construct doors with smooth flush surfaces, without visible joints or seams on exposed faces or stile edges. Interior and exterior door edge seams shall be full welded, except if polyurethane core is used for exterior, these doors shall have edges filled with body putty and ground smooth.
- F. Exterior Hollow Metal Door Louvers: Fabricate louver units of 16-gage galvanized steel sheets with stationary, weatherproof Z-shaped blades and U-shaped frames, not less than 1-3/8 inch thick. Space louver blades not more than 1-1/2 inch o.c. Assemble units by welding. Provide insect screen on interior side of frame, consisting of 14 by 18 wire mesh in rigid, formed metal frame.
 - 1. Interior Hollow Metal Door Louvers: Fabricate of 20-gage cold-rolled steel sheets with stationary sightproof inverted V-shaped blades and U-shaped frames. Space louver blades not more than 3 inches o.c. Assemble units by welding.

- G. Typical Reinforcement: Provide as required for hardware items. For lock reinforcement, provide manufacturer's standard reinforcement. Provide 12 gage reinforcement for escutcheons or roses. centering clips to hold lock case in alignment. For door checks, provide 3/16 inch channel type reinforcements, 3-1/2 inch deep by 14 inches long, or as required. Hinge reinforcement minimum 7 gage by 1-1/2 inch by 9 inch bar. Weld reinforcing to door. Reinforce doors for surface items such as surface and semi-concealed closers, brackets, surface holders and door stops. Drilling and tapping installation of these surface items shall be done in field by hardware installer.
- H. Special Reinforcing: At exterior doors, reinforce inside of door on hinge side with high frequency hinge preparation. Weld to door.
- I. Hardware: Mortise, reinforce, drill and tap for hardware furnished under Section 087000 - Hardware, except drilling and tapping for surface door closers, door closer brackets and adjusters shall be done in field. Obtain templates from hardware supplier.
- J. Finish: Provide prime coat finish on doors. Thoroughly clean off rust, grease and other impurities. Grind welds smooth, no marks shall show. Apply metallic filler as required to fill cracks and joints and to level any weld areas or similar imperfections. Sand filler coat smooth.
- K. Provide and coordinate to safety features required at risk areas as indicated AND
 - 1. Prep for anti-ligature locksets and levers, with no protruding openings or of a closed type.
 - a. Provide Anti-ligature leaf features, hinges and other hardware where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Heavy duty, institutional grade.
 - c. Tamper resistant fasteners.
 - d. Pick resistant sealants.
 - e. Anti-ligature hardware, gaskets and backer rods.
 - f. Flush or sloped surface and free from toe holds and profiles that can be used to climb.

2.6 FASTENINGS

- A. Provide fastenings, anchors and clips as required to secure hollow metal work in place. Provide Jackson head screws, or flatter. Dimple metal work to receive screw heads. Set stops and other non-structural fastenings with #6 Jackson head self-tapping screws.
- B. Provide and coordinate fasteners to safety features required at risk areas as indicated AND
 - 1. Provide flush connections with no protruding openings or of a closed type.
 - a. Provide Anti-ligature installation and assemblies where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Tamper resistant fasteners.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine supporting structure and conditions under which hollow metal is to be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.
- B. Check floor flatness and levelness across the entire operational path of leaves so that no commissioning or operational issues with regard to closers, smoke tight door bottoms or bolts will occur.

3.2 INSTALLATION

- A. Install hollow metal in accordance with reviewed shop drawings and manufacturer's printed instructions. Securely fasten and anchor work in place without twists, warps, bulges or other unsatisfactory or defacing workmanship. Set hollow metal plumb, level, square to proper elevations, true to line and eye. Set clips and other anchors with Ramset "shot" anchors or drill in anchors as approved. Units and trim shall be fastened tightly together, with neat, uniform and tight joints.

- B. Placing Frames: Set frames accurately in position, plumb, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.
 - 1. At acoustic rated metal stud and gypsum board partitions, install insulation within frames.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
 - 3. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction. Provide adjustable wedged or bolted anchorage to frame jamb members.
 - 4. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.
- C. Place fire-rated frames in accordance with NFPA Standard #80.
- D. Door Installation: Fit hollow metal doors accurately in their respective frames, within following clearances: Jambs and head 3/32 inch, meeting edges pair of doors 1/8 inch, sill where no threshold or carpet 1/4 inch above finished floor, sill at threshold 3/4 inch maximum above finished floor, sill at carpet 1/4 inch above carpet. Place fire-rated doors with clearances as specified in NFPA Standard #80.
- E. Install to provide all safety features required at risk areas as indicated AND
 - 1. Provide flush surfaces with no protruding openings or of a closed type.
 - a. Provide Anti-ligature installation and assemblies where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Tamper resistant fasteners.
 - c. Pick resistant sealants.

3.3 ADJUSTING AND CLEANING

- A. Prime Coat Touch-Up: Immediately after installation, sand smooth rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.
- B. Protection Removal: Immediately before final inspection, remove protective wrappings from doors and frames.

END OF SECTION

SECTION 081400 WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Prefinished solid core flush wood doors
 - a. Fire rated flush wood doors.
 - b. Non-rated flush wood doors.
- B. Related Sections:
 - 1. Section 064000 - Architectural Woodwork.
 - 2. Section 081113 - Hollow Metal Doors and Frames.
 - 3. Section 087100 – Door Hardware.
 - 4. Section 088000 - Glazing: Glass and glazing for doors.

1.2 REFERENCES

- A. AWS - Architectural Woodwork Standards Adopted and Published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturer's Association of Canada and Woodwork Institute - Current Edition.
- B. NFPA No. 80 Standards for Fire Doors.
- C. Design Guide for the Built Environment of Behavioural Health Facilities, Edition 7.0, FGI & NAPHS

1.3 SUBMITTALS

- A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.
- B. Shop Drawings:
 - 1. Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data.
 - a. Indicate hardware locations
 - b. Indicate locations of cut-outs for glass and louvers.
 - c. Indicate thickness of veneers.
 - d. Indicate requirements for veneer matching.
 - e. Indicate doors to be factory finished and finish requirements.
- C. Samples:
 - 1. Submit samples of wood veneer and factory finishing as follows:
 - a. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.
 - 1) For each wood species and transparent finish, provide set of 3 samples showing typical range of color and grain to be expected in finished work.
- D. Quality Assurance Submittals:
 - 1. Humidity and temperature reading taken before, during and after installation.
 - 2. Certificates: Submit certification that doors and frames comply with NFPA 252 or UL-10.

1.4 QUALITY ASSURANCE

- A. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 or UL-10C.
 - 1. Provide gasket as required by door manufacturer in compliance with UL-10C, Category A.

2. Oversize, Fire-Rated Wood Doors: For door assemblies exceeding sizes of tested assemblies, provide oversize fire door label or certificate of inspection, from a testing and inspecting agency acceptable to authorities having jurisdiction, stating that doors comply with requirements of design, materials, and construction.
- B. Fire-Rated Wood Door and Frame Assemblies: Provide wood doors and frames which are identical in materials and construction to units tested in door and frame assemblies in accordance ASTM E152 and which are labeled and listed for ratings indicated by UL or other testing and inspection agency acceptable to authorities having jurisdiction.
- C. Quality Standard: AWS "Architectural Woodwork Quality Standards Illustrated".
 1. Provide WIC-Certified Compliance Certificate indicating that doors comply with requirements of grades specified.
 2. Provide WIC-Certified Compliance Certificate for installation.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of referenced standard and manufacturer's written instructions.
- B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting
 1. Stack wood doors as recommended by door manufacturer.
 2. Use opaque plastic sheeting for natural finished doors.
- C. Mark each door on top and bottom rail with opening number used on Shop Drawings

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver materials until building is conditioned to temperature and humidity required for location of project per AWS requirements.
 1. Maintain temperature and relative humidity that will exist during occupancy for at least 10 days prior to delivery.
 2. Maintain temperature and relative humidity at occupancy levels during the remainder of the construction period during construction
 3. Monitor and record temperature and humidity before, during and after installation.
- B. Protect wood doors from damage, dust and dirt; prior to and after installation.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in 3-inch span.
 1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
 2. Warranty shall be in effect during the following period of time from date of Substantial Completion:
 - a. Solid-Core Interior Doors: Life of installation

PART 2 PRODUCTS

2.1 WOOD DOORS, GENERAL

- A. Quality Standard: Provide wood doors that comply with Architectural Woodwork Standards Adopted and Published jointly by Architectural Woodwork Institute, Architectural Woodwork Manufacturer's Association of Canada and Woodwork Institute - Current Edition (AWS).
- B. Source Limitations: Obtain flush wood doors from single manufacturer.
- C. Provide and coordinate to safety features required at risk areas as indicated AND
 1. Prep for anti-ligature hinges, locksets and levers, and accessories with no protruding openings or of a closed type AND normal institutional grade installations or as outlined under C.1.a.

- a. Provide Anti-ligature leaf features and prep for safety hardware, where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
- b. Heavy duty, institutional grade.
- c. Tamper resistant fasteners.
- d. Pick resistant sealants.
- e. Anti-ligature hardware, gaskets and backer rods.
- f. Flush or sloped surface and free from toe holds and profiles that can be used to climb.
- g. Provide anti-barrier (wicket or other per referenced guidelines) doors at 50% of patient rooms.
- h. Maintain all Fire Resistance ratings, accessible operation, and other referenced standards.

2.2 NON-FIRE RATED DOOR TYPES

- A. Non-Fire Rated Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to AWS PC-5 (ME);
 - 1. AWS Construction Grade: Custom.
 - 2. Core: 32 pcf density, Type 1 particle board; for doors indicated to have full light, provide structural composite lumber (SCL) core as may be required by the manufacturer to maintain lifetime manufacturer's warranty in Article 1.7.
 - 3. Adhesive: Type 1 for hot press application.
 - 4. Stiles: Hardwood to match face veneer over structural composite lumber (SCL), glued to core.
 - 5. Rails: Mill option hardwood or SCL. Top and bottom: 5 inches.
 - 6. Crossbanding: 1/20 inch thick hardwood.
 - 7. Facing (WD): Wood veneer as specified.

2.3 FIRE RATED DOOR TYPES

- A. Fire Rated Flush Doors: Thickness: 1-3/4 inches, interior flush wood, bonded, solid core conforming to AWS FD 1-1/2, FD 1, and FD 3/4;
 - 1. AWS Construction Grade: Custom
 - 2. Core: Mineral core.
 - 3. Adhesive: Type 1 for hot press application.
 - 4. Stiles: Hardwood to match face veneer over structural composite lumber (SCL), glued to core. Thickness as required to meet fire rating.
 - 5. Rails: Mill option hardwood or SCL. Top and bottom: 5 inches.
 - 6. Crossbanding: 1/20 inch thick hardwood.
 - 7. Facing (WD): Wood veneer as specified.
 - 8. Label: Attach UL or WHI label to hinge side of door.

2.4 DOOR FACING

- A. Shop-Finished Doors: Provide finished doors which have been final finished in shop prior to shipping.
- B. Wood Veneer: AWS Grade AA, 1/50 inch thick before final sanding.
- C. Species with Transparent Finish: refer to Section 064000.
- D. Veneer Matching:
 - 1. Match between Veneer Leaves: Book match.
 - 2. Assembly of Veneer Leaves on Door Faces: Balance match.
 - 3. Pair and Set Match: Provide for doors hung in same opening.
 - 4. Room Match: Match door faces within each separate room or area of building.
 - 5. Exposed Vertical and Top Edges: Same species as faces.
- E. Finish: Premium Grade stain and transparent finish, in accordance with AWS Quality Standards Section 1500, AWS System No. TR-6, Conversion Varnish.
- F. Factory-Finished Doors: Provide finished doors which have been finished at the factory prior to shipping.

2.5 ACCESSORIES

- A. Fabrication Adhesives:
 - 1. Facing and Crossband Adhesive: Type 1 waterproof.
 - 2. Door Construction: Type 2.
- B. Impact Resistant Plastic: Prep for items specified elsewhere and provide as specified AND
 - 1. Replaceable edges.
 - 2. Surface protection sheets.
 - 3. Kickplates.
 - 4. Compliant to required FR listings, safety features and standards as indicated.
 - 5. In all service and patient areas and entire ARF and MHRC facilities.
- C. Vision Frames:
 - 1. Non-rated doors: Flush wood frames, hardwood to match facing.
 - 2. 20 minute fire rated doors: Flush wood frames, hardwood to match facing
 - 3. Fire-rated doors: UL approved wood veneer stop system.
 - 4. Glass: Refer to Section 088000 for glass types.

2.6 FABRICATION

- A. Fabricate wood doors in accordance with requirements of AWS and specified AWS requirements that are a part of AWS.
- B. Fabricate Work of this Section using materials, methods and quality control procedures necessary for installed units to withstand dimensional changes that can be expected resulting from temperature and humidity variations at project location when interior spaces do not have humidity control. Seal each surface to help mitigate dimensional change resulting from temperature and humidity variations.
- C. Fabricate and label fire-rated doors in accordance with requirements of Underwriters' Laboratories (UL), UL-10C, Category A Positive Pressure, with intumescent required for compliance contained within the door (concealed) and requiring no additional installation of intumescent products.
- D. Fabricate doors with AWS Quality Standards hardware blocking options as follows:
 - 1. Provide head and sill blocking rails on all doors.
 - 2. Provide adequate blocking for doors specified with concealed overhead stops and surface mounted closers.
 - 3. Provide lock-block at fire-rated, mineral core doors at latch side only.
 - 4. Provide cross blocking only when exit devices are specified for door.
 - 5. Provide hook block for pivots, or when floor bolts are specified under Section 087100 - Door Hardware.
- E. Exposed Vertical Edges: Veneer of same species as face, bonded to structural composite lumber, concealing edges for crossband..
 - 1. Bevel strike edge of single acting doors 1/8 inch in 2 inches. Radius strike edge of double-acting swing doors 2-1/8 inches.
- F. Horizontal Edges: Provide doors with minimum 1-1/4 inch thick edge strips, of wood species to match face veneers except as required for UL rating.
- G. Cut-Outs: Make cut-outs and provide stops for glass and louvers. Factory install metal door louvers. Seal cut-outs prior to installation of moldings.
 - 1. For full light doors: Provide cut out from flush wood door, with vertical grain direction.
- H. Hardware: Prepare doors to receive hardware. Refer to Section 087100 – Door Hardware and NFPA 80 for hardware requirements including UL-10C.
 - 1. Factory pre-machine doors for all mortised hardware, including pilot holes for hinge screws and lock fronts.
 - 2. Prefit and bevel to net opening size less approximately 3/16 inch in width and provide 1/4 inch clearance above finished floor, unless otherwise indicated on drawings.
 - 3. Slightly ease vertical edges.

- I. Fire Rated Pair of Doors; greater than 20 minute or smoke rated: If astragal is required, to comply with fire rated labeling requirements for pairs of fire rated doors, provide door manufacturer's standard tested astragal.
 1. Shop apply astragals.
 2. Shop apply matching veneer wrap to conceal metal astragal at wood faced doors.
 3. Install **concealed** intumescent seals per UL-10C where required by code.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Check floor flatness and levelness across the entire operational path of leaves so that no commissioning or operational issues with regard to closers, smoke tight door bottoms or bolts will occur.
- B. Check door leaves at delivery and again before installation.
 1. Reject doors with defects.
- C. Examine installed door frames before hanging doors.
 1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
 2. Reject door frames with defects.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Hardware: For installation, refer to Section 087100 - Door Hardware.
- B. Manufacturer's Written Instructions: Install doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.
 1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80
- C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.
 1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold.
 2. Comply with NFPA 80 for fire-rated doors.
- D. Ensure that smoke gaskets are in-place before prefinished door installation.
- E. Provide and coordinate to safety features required at risk areas as indicated AND
 1. Prep for anti-ligature locksets and levers, with no protruding openings or of a closed type.
 - a. Provide Anti-ligature leaf features, hinges and other hardware where indicated AND
 - 1) in all B occupancy common areas above risk level 1 of the NAPHS / FGI Guideline and
 - 2) all areas of the ARF and MHRC.
 - b. Heavy duty, institutional grade.
 - c. Tamper resistant fasteners.
 - d. Pick resistant sealants.
 - e. Anti-ligature hardware, gaskets and backer rods.
 - f. Flush or sloped surface and free from toe holds and profiles that can be used to climb.

3.3 INSTALLED DOORS

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

- C. Protection: Protect installed surfaces from damage or soiling .and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
 - 1. At clear finished doors, do not partially cover door surfaces with paper, cardboard, or other opaque covering that will create uneven aging of wood veneer.

END OF SECTION

SECTION 083100 ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Access panels and accessories.
- B. Related Sections:
 - 1. Section 092216 – Supports for Gypsum Board.
 - 2. Section 092900 - Gypsum Board.
 - 3. Section 099000 – Painting: Field painting.

1.2 SUBMITTALS

- A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, finishes, and fire ratings (if required) for access doors and frames.
- B. Shop Drawings: Submit for each item of work in accordance with Section 013300 showing location and size of proposed access panels.
- C. Schedule: Provide complete access panel schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Deliver and protect as required during handling to preclude damage. Replace damaged units.

1.4 COORDINATION

- A. Provide panels as part of this Contract needed to access concealed equipment and controls whether shown on drawings or not.
- B. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.
- C. Provide one universal keyway for all access door and/or panel types. Contractor to coordinate between trades, where applicable.

PART 2 PRODUCTS

2.1 ACCESS PANELS

- A. (AP) Non-rated, flush metal access panel.
 - 1. Metal access door flush panel for gypsum board.
 - 2. Accessories: Cylinder lock.
 - 3. Factory Finish: Prime coat.

2.2 FABRICATION

- A. Weld and grind smooth joints of fabricated components.
- B. Form exposed surfaces from one sheet of stock, free of joints.
- C. Provide steel anchor plates and anchor components for installation of building finishes.
- D. Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.
- E. Back paint components where contact is made with building finishes to prevent electrolysis.
- F. Hot dip galvanized ferrous metal anchors and fastening devices.

- G. Shop assemble components and package complete with anchors and fittings.

PART 3 EXECUTION

3.1 PREPARATION

- A. Deliver inserts and rough-in frames to job site at appropriate time for building-in. Provide templates and rough-in measurements as required.
- B. Before starting work notify Architect in writing of conflicts detrimental to installation or operation of units.
- C. Verify with Architect location of access panels.
- D. Advise installers of other work about specific requirements relating to access panel and floor door installation, including sizes of openings to receive access panel or access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.2 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access panels and frames, and floor doors and frames.
- B. Install plumb, square and level, securely fastened, properly anchored and ready for full, complete operation and use.
- C. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.
- D. Install access doors with trimless frames and floor doors flush with adjacent finish surfaces or recessed to receive finish material.
- E. Adjust and lubricate operating parts for proper operation.

3.3 ACCESS PANEL SCHEDULE

- A. General: The following are general recommendations for selecting access panel types and sizes, unless noted otherwise or as indicated on the drawings. Access panels typically are located for access to mechanical equipment and controls, located above hard ceilings (gypsum board) or walls of differing construction and finishes. Confirm access panel type, size and location with the Architect.
- B. Type:
 - 1. (AP): Typical non-rated hard ceilings and walls.
- C. Size by access requirement:
 - 1. 12 inch by 12 inch: Hand access.
 - 2. 18 inch by 18 inch: Arm access.
 - 3. 24 inch by 24 inch: Arm and head access.
 - 4. 30 inch by 24 inch: Head and torso access.
 - 5. 36 inch by 36 inch: Ladder access.
- D. Ceiling or wall access panels required to access a mechanical access panel (MAP), (AP) should be slightly larger than the (MAP) and centered on the panel.

END OF SECTION

SECTION 083326 OVERHEAD COILING GRILLES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Roll up metal grillage with accessories; manual crank operation.
- B. Related Sections:
 - 1. Section 055000 - Metal Fabrications: Steel support framing.
 - 2. Section 061000 - Carpentry: Wood blocking and cross head support.
 - 3. Section 087100 – Door Hardware: Cylinder core and keys.

1.2 REFERENCES

- A. ANSI/UL 325 - Door, Drapery, Gate, Louver, and Window Operators and Systems.

1.3 SYSTEM DESCRIPTION

- A. Manual crank unit with overhead counter balance device.

1.4 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300. Indicate opening sizes, details of grillage, track and hardware, attachments, related and adjacent work, materials and finishes.
- B. Samples: Submit representative sample of grillage with specified finish in accordance with Section 013300.

1.5 QUALITY ASSURANCE

- A. Provide each overhead coiling grille as complete unit produced by one manufacturer, including hardware, accessories, mounting and installation components.
- B. Installer Qualifications: Engage experienced installer who is authorized representative of overhead coiling grille manufacturer for both installation and maintenance of units required for this Project.
- C. Operation-Cycle Requirements: Design overhead coiling grille components and operator to operate for not less than 20,000 cycles.

PART 2 PRODUCTS

2.1 OVERHEAD COILING GRILLES

- A. (CG) Aluminum overhead coiling grille with accessories:
 - 1. Grille Curtain Material: Aluminum.
 - 2. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.
 - 3. Hood: Aluminum.
 - a. Shape: Square.
 - b. Mounting: As shown on Drawings.
 - 4. Locking Devices: Equip grille with locking device assembly.
- B. Usage Classification: Medium duty, up to 15 cycles per hour.
- C. Manual Operation: Crank type.

E. Aluminum Finish:

1. High Performance Organic Coating Finish: Comply with AA-C12-C42-R1x, prepare, pretreat and apply coating as specified below to comply with manufacturer's written instructions
2. Fluoropolymer 3-Coat Coating System: Manufacturer's standard 3-coat thermocured system of primer and fluoropolymer color coat and clear fluorocarbon topcoat with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2605, (similar to Hylar 5000 or Kynar 500).
 - a. Custom color as selected by Architect.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install overhead coiling grilles in accordance with manufacturer's written instruction.
- B. Fit, align, and adjust assemblies level and plumb for smooth operation.
- C. Adjust grilles and operating hardware.

END OF SECTION

SECTION 083613 SECTIONAL DOORS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electrically operable energy-efficient metal sectional overhead doors (SD).
 - 2. Electrical wiring from makeup box to electric operators and control stations.
 - 3. Operators, control stations, and remote-control transmitters.
- B. Related Sections:
 - 1. Section 055000 - Metal Fabrications: Steel channel framing for door openings and steel plate at wall for shaft mounting.
 - 2. Division 26 - Electrical: Service to makeup box located on electric door operators. Empty conduit from control stations to door operators.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- A. Submit shop drawings and product data in accordance with Section 013300.
 - 1. Indicate pertinent dimensioning, general construction, component connections and details, anchorage methods, hardware locations and installation details.
- B. Samples: Submit samples of door finish in accordance with Section 013300, for color selection and appearance acceptance.

1.3 DELIVERY OF MATERIALS

- A. Deliver doors in manufacturer's packaging complete with installation instructions.

1.4 QUALITY ASSURANCE

- A. Provide each sectional overhead door as complete unit produced by one manufacturer, including frames, sections, brackets, guides, tracks, counterbalance mechanisms, hardware, operators and installation accessories, to suit openings and head room allowable.
- B. Wind Loading: Design and reinforce sectional overhead doors to withstand 20 lb per sq ft wind loading pressure.
- C. Installation: By overhead door manufacturer's authorized installer.
- D. Label: Provide on electrical equipment.

PART 2 PRODUCTS

2.1 SECTIONAL DOOR TYPE

- A. (SD) Standard lift insulated overhead sectional doors with flush steel door panels and glazed panels, electrically operated, manually operable in case of power failure.

2.2 COMPONENTS AND MATERIALS

- A. Door Sections: Steel sandwich construction, 1-3/4 inch thick, 25-gauge exterior skin and 26-gauge interior skin with injected polyurethane foam insulated core, stucco embossed hot-dipped galvanized (G60) steel complying with ASTM A653, with galvanized steel horizontal hinge reinforcement strips and end stiles.
- B. Mounting: Lap jamb angle mounting as recommended by door manufacturer.
- C. Insulation: Polyurethane foam with R-value of 16.4.

- D. Section Joint Seals: Interior and exterior skins separated by continuous hot melt seal to form effective thermal break and complete weatherseal along section joint.
- E. Finish and Color: Exterior skin with 2-coat factory finish, one coat primer and Kynar type finish coat as selected by Architect.
- F. Glazed Panels: Full infill panel insulating glass; 2 panes of 3/16 inch glass; set in place using moldings consistent with door panel construction.
- G. Tracks: Galvanized steel; 3 inches wide; continuous vertical mounted with galvanized steel angles of same gage as tracks; horizontal length.
- H. Hinge and Roller Assemblies: Heavy duty hinges and adjustable roller holders of galvanized steel; full floating hardened steel ball bearing rollers; located at every sill and rail meeting point.
 - 1. Rollers: 3 inch diameter nylon rollers as recommended by door manufacturer.
- I. Weatherstripping: Fitted at bottom of doors, full length; double contact resilient, flexible vinyl strip type.
- J. Lift Mechanism: Warranted 100,000 cycle torsion spring on cross head shaft, with braided steel lift cables and tamper proof counter.
- K. Electric Operators: UL approved; center mounted draw bar assembly: 12 inches per second operation; motor size and type as recommended by door manufacturer for door sizes indicated, adjustable friction clutch double shoe brake system actuated by independent full line voltage solenoid controlled by motor starter; fully enclosed positive gear driven limit switch; fully enclosed magnetic cross line reversing starter.
- L. Control Station: Standard 3 button (open-close-stop) type, for each electric operator; 24 volt circuit; surface mounted.
- M. Automatic Reversing: At bottom of doors, full width; electromechanical type; wired to stop, reverse door upon striking object; neoprene covered to provide weather seal.
- N. Remote –Control Transmitters: As recommended by door and opener manufacturer. Provide total of 5 transmitters for Owner's use.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install overhead sectional doors complete with electric operators and controls, in accordance with reviewed shop drawings and manufacturer's recommendations. Coordinate installation with electrical service.
- B. Fit, align, and adjust complete door assembly level and plumb, and to provide smooth operation.
- C. Securely brace overhead door tracks suspended from structure. Secure tracks to structural members only.
- D. Upon completion of installation, including work by other trades, lubricate, test and adjust doors to operate easily, free from warp, twist, or distortion and fitting weather tight for entire perimeter.

END OF SECTION

SECTION 084400
ALUMINUM CURTAIN WALLS, WINDOWS AND ENTRANCES

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Aluminum tube frame system, curtain walls, window-walls and windows.
 - 2. Aluminum entrance doors and frames.
 - 3. Glass and glazing.
 - 4. Fixed aluminum sun control device.
 - 5. Anchors, brackets, reinforcements and attachments.
 - 6. Sealant at aluminum curtain walls, windows and entrances.
 - 7. Field testing of glazed aluminum curtain walls.
- B. Related Sections:
 - 1. Section 050000 – Division 05 Metals: Structural steel framing.
 - 2. Section 055000 - Metal Fabrications: Fabricated metal framed opening.
 - 3. Section 061000 - Rough Carpentry: Framed blocking. Wood perimeter shims.
 - 4. Section 079000 - Joint Protection: Other sealants and back-up materials.
 - 5. Section 085113 - Aluminum Windows.
 - 6. Section 087100 – Door Hardware: Entrance door hardware.
 - 7. Section 088000 - Glazing: Other glass and glazing.

1.2 SYSTEM DESCRIPTION

- A. High-rise aluminum thermally broken curtain wall framing system (with windows)(and entrance framing systems) designed to accept 1 inch glazing material.
 - 1. (CW): Pre-fabricated, field assembled, pressure wall.

1.3 REFERENCES

- A. Aluminum Design Manual 2000.
- B. Aluminum Standards and Data 2000.
- C. AAMA MCWM-1
- D. AAMA/NWWDA 101/I.S.2 97(Revised 12/99) Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors.
- E. AAMA 503 - Field Check of Water Penetration through Installed Exterior Windows, Curtain Walls, and Doors by Uniform Pressure Difference.
- F. ANSI A58.1/ASCE 7-02 - Minimum Design Loads for Buildings and Other Structures.
- G. AAMA 2605 Specification for High Performance Organic Coatings on Architectural Aluminum Extrusions and Panels.
- H. California Building Code.
- I. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections.
- J. The Aluminum Association – “Specification for Aluminum Structures”.

1.4 SYSTEM PERFORMANCE – STRUCTURAL

- A. Design Loads: Design and construct curtain wall system, including anchorages, to withstand dead loads of curtain wall system and the following wind and seismic loads:
 - 1. Wind loads caused by pressure and suction of wind acting normal to plane of wall as calculated in accordance with requirements of authorities having jurisdiction or ASCE 7, whichever are more stringent. Wind Load Provisions of ASCE 7 as shown on Structural Drawings.

2. Seismic loads in any direction in accordance with ASCE 7 and Section 017325
- B. Deflection of building cladding members in a direction normal to plane of wall when subjected to design wind loads or concentrated maintenance loads shall be limited to following:
 1. Spans up to 13 feet-6 inches: limit deflection to $L/175$.
 2. Spans greater than 13 feet-6 inches: limit deflection to $L/240$ plus 1/4 inch.
 3. Cantilevered members: limit deflection to lesser of $2L/175$ or 3/4 inch.
 4. No permanent deformation in excess of 0.2 percent of its span.
 5. The deflection of any member (such as vertical jambs) shall not impair the function of or damage any joint seals as warranted by the manufacturer.
 - C. The deflection of building cladding members in a direction parallel to the plane of the wall shall not exceed an amount which will reduce the glass bite below 75 percent of design dimension, and member shall have a minimum 1/8 inch clearance between itself and edge of fixed panel, glass or fixed part immediately below.
 - D. Structural Support Movement: System to accommodate anticipated interstory differential live load vertical movement of 5/16 inch (downward) in addition to anticipated thermal movement.
 - E. Sidesway Movement: System to accommodate anticipated interstory differential drift of $H/400$ in any horizontal direction when subjected to design wind loads.
 - F. Seismic Performance: Design and construct system, including anchorage, to withstand seismic forces in any direction.
 - G. Seismic Interstory Drift: System shall accommodate anticipated seismic relative displacement in plane and out of plane of wall system in accordance with Section 017325.
 - a. Glass and glazing shall meet the requirement as indicated in Section 017325 in accordance with ASCE 7, Section 13.5.9.

1.5 SYSTEM PERFORMANCE – THERMAL AND INFILTRATION

- A. Thermal Movement: System to provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F without causing detrimental effects to system or components.
- B. Thermally Broken Construction: Provide systems that isolates aluminum exposed to exterior from aluminum exposed to interior with material of low thermal conductance.
- C. Transmission Characteristics of Framing: Comply with requirements indicated below for transmission characteristics and test methods.
 1. Air Infiltration: Air infiltration of not more than 0.06 CFM per square foot of fixed area at 6.24 psf unless ASTM E283, applicable AAMA or manufacturer's data methods require a higher pressure.
 - a. Limit air infiltration to 0.10 cu. ft/min/lineal foot of sash crack for operating sash.
 2. Water Leakage: No uncontrolled water penetration per ASTM E331 and AAMA 503 at pressure differential of 15.00 psf.
 3. Thermal Resistance of Wall System (Excluding Vision Glass Areas): U-value of 0.65 BTU/sq ft. per AAMA 1503.1.
 4. Condensation: Achieve not less than 71 CRF per AAMA 1503 so condensation is not formed on interior frame and interior window surfaces at following conditions unless project humidity conditions and specific location conditions are more severe per ASHRAE Handbook of Fundamentals, Weather Data and Design Conditions.
 - a. Interior Air Temperature: 75 degrees F.
 - b. Interior Humidity: 30 percent.
 - c. Exterior Air Temperature: 45 degrees F.
 - d. Wind Speed: 15 miles per hour unless other indicated.
- D. Transmission Characteristics of Entrances: Provide entrance doors with jamb and head frames which comply with requirements indicated below for transmission characteristics and test methods.
 1. Air Leakage: Air infiltration per linear foot of perimeter crack of not more than 0.50 CFM for single doors and 1.0 CFM for pairs of doors per ASTM E283 at pressure differential of 1.567 psf.

2. Thermal Transmittance: U-value of not more than 0.93 Btu per AAMA 1503.
 3. Condensation Resistance: Not less than 48 CRF per AAMA 1503.
- E. Sound Attenuation Through-Wall System (Exterior to Interior): STC 30.
 - F. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior.
 - G. Maintain continuous air and vapor barrier throughout assembly primarily in line with (inside) pane of glass and heel bead of glazing sealant.
 - H. Not Permitted: Vibration harmonics; wind whistles; noises caused by thermal movement; thermal movement transmitted to other building elements; loosening, weakening, or fracturing of attachments or components of system.

1.6 SUBMITTALS

- A. Shop Drawings: By system manufacturer shall include the following:
 1. Plans, elevations, and sections.
 2. System and component dimensions.
 3. Details of components within assembly.
 4. Framed opening requirements and tolerances.
 5. Fasteners and attachments clearly indicating reactions to supporting elements and assumed eccentricities.
 6. Glass and infills.
 7. Anticipated deflection under load.
 8. Affected related work.
 9. Expansion and contraction joint locations and details.
 10. Drainage details and flow diagrams.
 11. Field welding.
 12. Show design criteria on shop drawings and certify by qualified professional engineer. Only submit calculation upon request.
- B. Product Data: Submit product data for each product specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.
 1. Submit substantiating test results of previous testing meeting performance criteria, and other supportive data.
- C. Samples: Submit samples illustrating prefinished aluminum surface, specified glass and insulated infill panels, including glazing edge and corner, and glazing materials.
- D. Certifications:
 1. Manufacturer certificate signed by manufacturer certifying compliance with requirements of Quality Assurance article.
 2. Installer certificates signed by manufacturer certifying that installer complies with requirements of Quality Assurance article.
 3. Professional Engineer certificate signed by manufacturer certifying that Professional Engineer complies with requirements of Quality Assurance article.
- A. Calculations: Structural design shall be performed by a Professional Engineer, licensed in the state where Project is located, indicating structural integrity of members, anchors, fasteners and connections to building structure, in accordance with specified criteria. Submit signed engineering calculations concurrently with the shop drawings to Architect/Engineer upon request.
 1. Engineering Responsibility: Calculations shall be reviewed for stated design assumptions, general compliance to specified requirements, and forces imposed on structure. The accuracy of the design calculations shall be the sole responsibility of the Contractor's Professional Engineer.

1.7 QUALITY ASSURANCE

- A. System Manufacturer Qualifications: Company specializing in aluminum curtain wall systems with minimum of 5 years experience.

- B. Installer Qualifications: Engage an installer with a minimum of 5 years experience to assume engineering responsibility and perform work of this Section who has specialized in installing glazed aluminum curtain wall systems that are similar to those indicated for this Project in material, design, and extent.
 - 1. Curtain wall manufacturer shall review and approve qualifications of installer, indicating manufacturer's verification that installer meets minimum requirements.
- C. Professional Engineer Qualifications: A professional engineer, who is legally qualified to practice in the state where the project is located, with a minimum of 10 years experience in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of glazed aluminum curtain wall systems that are similar to those indicated for this Project in material, design, and extent.
- D. Testing Agency: Contract with an independent testing agency to field-test installed curtain walls for compliance with specified performance criteria for air and water infiltration.
 - 1. Independent testing agency shall conduct tests and re-tests.
 - 2. Architect will determine which curtain wall units will be tested. Test area shall include perimeter sealant joint and corner or other unique features.
 - 3. Assist with testing procedures and otherwise cooperate with testing agency and be present to observe
 - 4. Failed curtain wall installations shall be removed, re-installed and re-tested until they pass.
 - 5. Re-testing and associated costs shall be paid for by Contractor.
 - 6. For each failed curtain wall test, an additional curtain wall unit shall be tested at Contractor's expense.
 - 7. Publish report of system modification made to allow system to pass test including specific actions to be taken by installer to help assure consistent quality control during installation of entire system on Project.
- E. One Installer for Total System: Company authorized by system manufacturer.
- F. Mock-Ups: Provide mock-ups of curtain wall system in accordance with Contract Documents to be field-tested for air and water infiltration.
 - 1. Mock-Up Pre-Installation Conference: Before beginning curtain wall mock-up construction and installation, conduct pre-installation conference at Project site with curtain wall system manufacturer, installer, Architect, Owner and other interested parties to review procedures, schedules, and coordination of curtain wall installation with other elements of Work.
 - a. Provide system sample for pre-installation meeting.
 - 2. Architect will observe complete installation of curtain wall mock-up.
 - 3. During construction of mock-up to be tested and during duration of onsite testing, the following individuals shall be present:
 - a. General Contractor's project manager
 - b. System fabricator's project manager
 - c. Installer's job superintendent that will actually be onsite supervising installation.
 - d. At least one installation laborer for each trade that will actually install systems on Project to perform mock-up construction and be present to make adjustments to mock-ups.
 - e. Owner's representative
 - f. Representative of Architect.
 - 4. Mock-up shall including intermediate mullion, sill muntin, vision glass light, and insulated infill panel.
 - 5. Coordinate with Work of other sections to include adjacent assemblies required to be included in mock-up.
 - 6. Mock-ups to demonstrate aesthetic effects and set quality standards for fabrication and installation.
 - 7. Mock-ups to demonstrate component assembly including integral glazing materials, weep drainage system, attachments, and anchors
 - 8. Mock-ups will pass field tests as specified herein and must be accepted by Architect prior to installation of remaining curtain wall and prior to payment for curtain wall materials.
 - 9. Accepted mock-up may remain as part of final work.

10. Pre-Installation Conference: After mock-ups testing is complete and testing agency has published its report, and prior to commencing installation of the remaining portions of the curtain wall system, convene a meeting to instruct installers and others that will oversee installation of systems regarding specific requirements resulting from testing that must be incorporated during installation.
- G. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code – Aluminum".

1.8 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle system components to prevent damage to finished surfaces.
- B. Store and protect system components in accordance with manufacturer's recommendations.
- C. Provide wrapping or strippable coating to protect prefinished aluminum surfaces. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

1.9 WARRANTY

- A. Provide manufacturer's warranty for 10 years on materials and 5 years on installation and workmanship.
- B. Warranty: Cover complete system for failure to meet specified requirements, including ability to exclude exterior moisture from interior.

PART 2 PRODUCTS

2.1 CURTAIN WALL TYPES

- A. (CW) Curtain wall, entrance framing, window-walls and window framing.
- B. Entrance Doors: Thermal barrier, heavy duty doors.
- C. (SCD) Sun control device.

2.2 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
 1. Sheet and Plate: ASTM B 209.
 2. Extruded Bars, Rods, Shapes, and Tubes: ASTM B 221.
- B. Steel Reinforcement: With manufacturer's standard corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.
 1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
 2. Cold-Rolled Sheet and Strip: ASTM A 611.
 3. Hot-Rolled Sheet and Strip: ASTM A 570/A 570M.
- C. Primer: FS TT-P-31; for shop application and field touch-up.
- D. Touch-Up Primer for Galvanized Surfaces: FS TT-P-641; TT-P-645.
- E. Fasteners Exposed to Weather: 300 Series stainless steel, type and size recommended by curtain wall manufacturer with exposed portions matching finish curtain wall system.
- F. Concealed Fasteners: ASTM A449, SAE Grade 5 carbon steel with cadmium and yellow chromate finish, type and size recommended by curtain wall manufacturer.
- G. Setting Blocks: Black EPDM 85±5 durometer, Shore-A per ASTM D 2000.

2.3 FABRICATED COMPONENTS

- A. Frames: Extruded aluminum profile; thermally broken with interior tubular section insulated from exterior pressure plate; matching stops and pressure plate of sufficient size and strength to provide bite on glass and infill panels; drilled drainage holes, deflector plates and internal flashings to accommodate internal weep drainage system.
- B. Reinforced Mullion: Profile of extruded aluminum cladding with internal reinforcement of steel shaped structural section.
- C. Infill Panel: Custom insulated aluminum panels.
- D. Closure Panel: 0.0625 inch thick aluminum, size and profile as indicated.
- E. Column Covers: 0.125 inch thick aluminum; full contact pressure bonded to internal stiffeners ensuring flat strong surface.
- F. (SCD) Sun Control Device: Cantilevered extruded aluminum frame and trellis, 2'-10" deep, clear anodized finish.
- G. Flashing: Aluminum same finish as for curtain wall aluminum section where exposed; secured with concealed fastening method.
- H. Fire Stop: Provide FRJS per Section 078443.

2.4 GLASS AND GLAZING

- A. Glass and Glazing Materials: As specified in Section 088000 - Glazing.

2.5 SEALANT

- A. Sealant and Backing Rod: As specified in Section 079000 - Joint Protection.

2.6 FABRICATION

- A. Form aluminum shapes before finishing.
- B. Fabricate curtain wall components allowing minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.
- C. Rigidly fit and secure joints and corners with screw and spline (internal reinforcement). Make joints and connections flush, hairline and weatherproof.
- D. Develop drainage holes with moisture pattern to exterior.
- E. Prepare components to receive anchor devices. Fabricate anchorage items.
- F. Arrange fasteners, attachments, and jointing to ensure concealment from view.
- G. Reinforce sections as necessary for hardware and loads.
- H. Reinforce interior horizontal as necessary for head rail to receive drapery track bracket and attachments.
- I. Reinforce framing members and attachments for window washing platform imposed loads.
- J. Complete fabrication and assembly at shop to minimize field cutting, splicing, fastening, sealing and similar work. Disassemble only to extent required for delivery and installation. Install operating sash in factory.
- K. Aluminum Finishes: Prepare surface for finishing in accordance with recommendations of aluminum producer and finisher. Finish components of assembly simultaneously so as to attain complete uniformity of color.
 - 1. Finish designations prefixed by AA conform to the system established by the Aluminum Association for designating aluminum finishes.

2.7 FINISHES

- A. Exposed Aluminum Surfaces:

1. High Performance Organic Coating Finish: Comply with AA-C12-C42-R1x, prepare, pretreat and apply coating as specified below to comply with manufacturer's written instructions
 2. Fluoropolymer 3-Coat Coating System: Manufacturer's standard 3-coat thermocured system of primer and fluoropolymer color coat and clear fluorocarbon topcoat with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2605, (similar to Hylar 5000 or Kynar 500).
 - a. Custom color as selected by Architect.
- B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A653 to 2.0 oz/sq ft.
- C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.
- C. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

- A. Coordinate dimensions, tolerances, and method of attachment with other work.

3.3 INSTALLATION

- A. Install curtain wall, window-wall, window and entrance system in accordance with reviewed shop drawings and manufacturer's instructions.
- B. Use method of attachment to structure permitting sufficient adjustment to accommodate construction tolerances and irregularities.
- C. Metal Protection: Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
- D. Anchorage: Provide alignment attachments and shims required to permanently fasten system to building structure as indicated on Shop Drawings.
 1. Provide separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
- E. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- F. Install components to drain water passing joints, condensation occurring in glazing channels, condensation occurring within framing members, and moisture migrating within the system to the exterior.
- G. Do not cut, trim, weld or braze component parts during erection in manner which would damage finish, decrease strength, or result in visual imperfection or failure in performance. Return component parts which require alteration to shop prefabrication, if possible, or for replacement with new parts.
- H. Provide thermal isolation where components penetrate insulation.
- I. Coordinate installation of fire stop insulation at each floor slab edge.
- J. Coordinate attachment and seal of air and vapor retarder materials. Install sill flashings.

- K. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- L. Install glass and glazing (and infill panels) in accordance with Section 088000 - Glazing.
- M. Install perimeter sealant and backing materials in accordance with Section 079000 - Joint Protection.
- N. Install firestopping with securely anchored metal flanges to prevent dislocation.

3.4 TOLERANCES

- A. Variation from Plane: 0.06 inches every 3 feet maximum or 0.25 inches per 100 feet, whichever is less.
- B. Misalignment of Two Adjoining Members Abutting in Plane: 0.015 inches.

3.5 FIELD TESTING

- A. Field test installed glazed aluminum curtain wall unit in accordance with AAMA 503 (pressure chamber with water spray apparatus), except that reduction of performance criteria for field testing is not allowed. Testing must be performed at the specified pressure.
- B. Perform air infiltration testing in accordance with applicable AAMA field method except reduction of performance criteria for field testing is not allowed.
- C. Perform not less than two tests in accordance with AAMA perform testing until test results from two tests are satisfactory.
- D. Include in test area adjacent wall materials so seal between window framing and rough opening is included in test.
- E. Perform testing by approved independent testing laboratory acceptable to Architect.

3.6 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces using solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by moderate use of mineral spirits or other solvent acceptable to sealant manufacturer.

END OF SECTION

SECTION 085113 ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Extruded aluminum windows with fixed frames and operating sash.
 - 2. Glass and glazing.
 - 3. Operating hardware and insect screens.
- B. Related Sections:
 - 1. Section 050000 - Metals: Steel lintels.
 - 2. Section 061000 - Carpentry: Wood perimeter shims.
 - 3. Section 064000 - Architectural Woodwork: Interior wood trim.
 - 4. Section 079000 - Joint Sealers: Perimeter sealants and back-up materials.
 - 5. Section 088000 - Glazing: Other glass and glazing.

1.2 SYSTEM DESCRIPTION

- A. (AW-1) Windows with fixed and outward opening side hinged sash.
- B. (AW-2) Mental Health window with secure vent, internal vent, and electrically operated internal blinds.

1.3 PERFORMANCE

- A. Window components to provide for expansion and contraction caused by cycling temperature range of 170 degrees F without causing detrimental effects to components.
- B. Design and size members to withstand dead loads and live loads caused by pressure and suction of wind as calculated in accordance with Uniform Building Code, as measured in accordance with ANSI/ASTM E330.
- C. Limit mullion deflection to 1/200 or flexure limit of glass with full recovery of glazing materials, whichever is less.
- D. Drain water entering joints, condensation occurring in glazing channels, or migrating moisture occurring within system, to exterior.
- E. Limit air infiltration through assembly to 0.06 cu ft/min/sq ft of assembly surface area of fixed frame and 0.10 cu ft/min/lineal ft of operating sash, measured at reference differential pressure across assembly of 0.3 inches water gage, as measured in accordance with ANSI/ASTM E283.
- F. Thermal Movements: Provide window units that allow thermal movement resulting from following maximum change (range) in ambient temperature when engineering, fabricating, and installing aluminum windows to prevent buckling, opening of joints, and overstressing of components, connections, and other detrimental effects. Base engineering calculation on actual surface temperatures of materials due to solar heat gain and nighttime sky heat loss.
 - 1. Temperature Change (Range): 120 degrees F, ambient; 180 degrees F, material surfaces.

1.4 SUBMITTALS

- A. Shop Drawings and Product Data: Submit by window manufacturer in accordance with Section 013300. Include wall opening and component dimensions; wall opening tolerances required; anchorage and fasteners; affected related work; installation requirements.
- B. Samples: Submit window finish for color selection in accordance with Section 013300.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Engage experienced Installer who has completed installation of aluminum windows similar in material, design, and extent to those required for this project and with record of successful in-service performance.
- B. Preinstallation Conference: Before beginning window installation, conduct preinstallation conference at Project site with window system manufacturer, installer, and other interested parties to review procedures, schedules, and coordination of window installation with other elements of Work.
- C. Single-Source Responsibility: Obtain aluminum windows from one source and by single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver and handle window units to prevent damage to finished surfaces.
- B. Store and protect window units in accordance with manufacturer's recommendations.
- C. Provide wrapping to protect prefinished aluminum surfaces.

1.7 WARRANTY

- A. Window manufacturers shall provide 10 year warranty from date of Substantial Completion, signed by officer of company. Warranties by installer or distributor will not be accepted.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Extruded Aluminum: ASTM B221 - 6063 alloy, T-5 temper.
- B. Sheet Aluminum: ASTM B209; 6063 alloy, T-6 temper.
- C. Stainless Steel: ASTM 167, Type 304 with #4 finish.
- D. Steel Sections: ASTM A36, A167; shapes to suit mullion sections.
- E. Primer: FS TT-P-31; red; for shop application and field touch-up.
- F. Touch-up Primer for Galvanized Surfaces: FS TT-P-641.

2.2 FABRICATED COMPONENTS

- A. Frames: Extruded aluminum; thermally broken with interior portion of frame insulated from exterior portion, flush glass stops of screw fastened type.
- B. Reinforced Mullions: Profile of extruded aluminum cladding with internal reinforcement of steel shaped structural section.
- C. Sills: Extruded aluminum; sloped for positive wash; one piece full width of opening.
- D. Insect Screens: FS RR-W-365, woven aluminum mesh; 14/18 mesh size; fitted taught in tubular aluminum frame; mitered and reinforced frame corners; with spring loaded steel retainer pins.
- E. Operable Sash Weatherstripping: Resilient PVC fin type extruded neoprene permanently resilient, profiled to effect weatherseal.
- F. Operable Sash Hardware: Manufacturer's standard corrosion resistant; positive position stop.
- G. Locks: Stainless steel locks, strikes and keepers for custodial key operation to secure sash in closed position and with limiter locks.
- H. Fasteners: Stainless steel with exposed portions matching finish of aluminum windows.
- I. Sealant Back-Stop Containment: At perimeter, provide not less than 1-1/2 inch continuous flush metal to permit sealant back-stop containment.

2.3 GLASS AND GLAZING MATERIALS

- A. Glass and Glazing Materials: As specified in Section 088000 - Glazing.

2.4 FABRICATION - GENERAL

- A. Factory fabricate and assemble windows allowing for minimum clearances and shim spacing around perimeter of assembly, yet enabling installation.
- B. Rigidly fit and weld joints and corners. Accurately fit and secure corners tight. Make corner joints flush, hairline, and weatherproof. Seal corner joints with sealant.
- C. Develop drainage holes with moisture pattern to exterior.
- D. Prepare components to receive anchor devices. Fabricate anchorage items.
- E. Prepare components with internal reinforcement for operating hardware.
- F. Provide internal reinforcement in mullions with galvanized steel members to maintain rigidity.

2.5 MENTAL HEALTH WINDOW – FABRICATION

- A. Mental health window to have a locked removable sash on interior, a secure operable vent at the base of the window, a motorized built-in blind between the exterior laminated/insulated glass unit and the interior laminated glass unit (removable sash).
 - 1. Mental health window shall pass testing per AAMA 501.8-12 Standard Test Method for Determination of Resistance to Human Impact of Window Systems Intended for Use in Psychiatric Applications.

2.6 FINISHES

- A. Coated Aluminum Surfaces: PVDF fluorocarbon coating complying with AAMA 2605 minimum 70 percent Hylar 5000 or Kynar 500 in custom color as selected by Architect.
- B. Concealed Steel Items: Galvanized in accordance with ANSI/ASTM A386 to 2.0 oz/sq. ft.
- C. Apply one coat of bituminous paint to concealed aluminum and steel surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine openings , substrates, structural supports, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances; rough opening dimensions; levelness of sill plate; coordination with wall flashings, vapor retarders, moisture barrier, and other built-in components; operational clearances; and other conditions affecting performance of work.
 - 1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
 - 2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches of opening.
 - 3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.

3.2 INSPECTION

- A. Verify wall openings and adjoining air and vapor seal materials are ready to receive work of this Section.
- B. Beginning of installation means acceptance of existing conditions.

3.3 INSTALLATION

- A. Install window frames, glass and glazing and hardware in accordance with manufacturer's instructions.

- B. Use anchorage devices to securely attach frame to structure.
- C. Align window frame plumb and level, free of warp or twist. Maintain dimensional tolerances, aligning with adjacent work.
- D. Coordinate attachment and seal of air and vapor retarder materials. Install under sill flashings.
- E. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to exterior.
- F. Pack fibrous insulation in shim spaces at perimeter to maintain continuity of thermal barrier.
- G. Install glass and glazing in accordance with Section 088000 - Glazing.
- H. Adjust operable hardware for smooth operation and tight fit of sash.

3.4 CLEANING

- A. Remove protective material from prefinished aluminum surfaces.
- B. Wash down exposed surfaces using solution of mild detergent in warm water, applied with soft, clean wiping clothes. Take care to remove dirt from corners. Wipe surfaces clean.

END OF SECTION

SECTION 086300 METAL-FRAMED SKYLIGHTS

PART 1 GENERAL

1.1 WORK INCLUDED

- A. Section Includes:
 - 1. Extruded aluminum skylight framing (SKLT M).
 - 2. Glass and glazing in skylights.
 - 3. Sealant and flashing at skylights.
- B. Related Sections:
 - 1. Section 076210 – Sheet Metal Flashing and Trim: Other metal flashing and sheet metal.
 - 2. Section 079000 - Joint Protection: Other sealants.
 - 3. Section 088000 - Glazing: Glass and glazing other than skylights.

1.2 REFERENCES

- A. AAMA 1600 - Voluntary Specification for Skylights.
- B. AAMA 1601.1 - Voluntary Standard Procedure for Calculating Skylight Annual Energy Balance.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide metal-framed skylights capable of withstanding loads and thermal and structural movements indicated without failure. Failure includes the following:
 - 1. Deflection exceeding specified limits.
 - 2. Thermal stresses transferred to the building structure.
 - 3. Framing members transferring stresses, including those caused by thermal and structural movement, to glazing.
 - 4. Noise or vibration created by thermal and structural movement and wind.
 - 5. Loosening or weakening of fasteners, attachments, and other components.
 - 6. Sealant failure.
- B. Deflection Limits: As follows:
 - 1. Deflection of the entire length of framing members in direction normal to glazing plane is limited to 1/180 of clear span or 3/4 inch, whichever is smaller, unless otherwise indicated.
- C. Lateral Support: Compression flanges of flexural members are laterally braced by cross members with minimum depths equal to 50 percent of flexural member depth and by anchors to the building structure. Glazing material does not provide lateral support.
- D. Structural Loads: Provide metal-framed skylights, including anchorage, capable of withstanding the effects of the following design loads when supporting full dead loads:
 - 1. Wind Loads: As indicated.
 - 2. Roof Loads: As follows:
 - a. Concentrated Load: 250 lbf applied to framing members at location that produces the most severe stress or deflection.
 - b. Live Load: As indicated.
 - c. Rain Load: As indicated.
 - 3. Seismic Loads: As indicated.
- E. Structural Performance: Provide metal-framed skylights, including anchorage, capable of withstanding test pressure indicated without material and deflection failures and permanent deformation of structural members exceeding 0.2 percent of span when tested according to ASTM E 330.
 - 1. Test Pressure: 150 percent of positive and negative wind-load design pressures.
 - 2. Test Duration: As required by design wind velocity; fastest 1 mile of wind for relevant exposure category.

- F. Thermal Movement: Provide metal-framed skylights that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, sealant failure, and other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F material surfaces.
- G. Water Penetration: Provide metal-framed skylights that do not evidence water penetration when tested according to ASTM E 331 at a minimum differential static pressure of 20 percent of positive design wind load, but not less than 6.24 lbf/sq. ft.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, dimensions and profiles of components, and finishes for metal-framed skylights.
- B. Shop Drawings: For metal-framed skylights. Include plans, elevations, sections, details, and attachments to other Work.
 - 1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
- C. Samples: Submit samples of aluminum framing for color selection and appearance acceptance.
- D. Warranty: Submit 2 copies of manufacturer's warranty for metal-framed skylights.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer to assume engineering responsibility who has specialized in installing metal-framed skylights similar to those indicated for this Project and who is acceptable to manufacturer.
- B. Engineering Responsibility: Preparation of data for metal-framed skylights, including Shop Drawings, based on engineering analysis of manufacturer's standard skylights similar to those indicated for this Project.
- C. 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 skylights that are similar to those indicated for this Project in material, design, and extent.
- D. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of metal-framed skylights. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, one another, and adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, or in-service performance

1.6 PRODUCT HANDLING

- A. Deliver skylight components in manufacturer's protective covering. Handle finished framing and glass with care to prevent damage.

1.7 PROJECT CONDITIONS

- A. Field Measurements: Where metal-framed skylights are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.8 WARRANTY

- A. Special Warranty: Written warranty, executed by manufacturer agreeing to repair or replace components of metal-framed skylights that fail in materials or installation quality within specified warranty period. Failures include, but are not limited to, the following:
 - 1. Structural failures.
 - 2. Sealant failures.

3. Failure of systems to meet performance requirements.
4. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
5. Water leakage; defined as uncontrolled water appearing on normally exposed interior surfaces of skylights from sources other than condensation. Water controlled by flashing and gutters and drained back to the exterior and that cannot damage adjacent materials or finishes is not water leakage.

B. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Aluminum: Alloy and temper recommended by manufacturer for use and finish indicated, and as follows:
 1. Extrusions: ASTM B 221 (ASTM B 221M).
 2. Sheet and Plate: ASTM B 209 (ASTM B 209M).
 3. Bars, Rods, and Wire: ASTM B 211 (ASTM B 211M).
- B. Brackets and Reinforcements: Provide manufacturer's standard high-strength aluminum brackets and reinforcements. Provide nonstaining, nonferrous shims to install and align skylights.
- C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing; compatible with adjacent materials.
- D. Exposed Flashing and Closures: Aluminum sheet.
 1. Minimum Thickness: 0.060 inch.
- E. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories; compatible with adjacent materials.
 1. Movement Joints: Provide slip-joint linings, spacers, and sleeves of material and type recommended by manufacturer.
 2. Aluminum-Retaining-Cap Fasteners: ASTM A 193/A 193M, Series 300 stainless-steel screws; type as recommended by manufacturer.
 3. Connections to Supporting Structure: ASTM A 307, zinc-coated steel fasteners.
 4. Anchor Bolts: ASTM A 307, Grade A, zinc-coated steel anchor bolts.
- F. Framing-System Sealants: Compatible with components with which sealants come in contact and recommended by skylight and sealant manufacturers for this use.
- G. Bituminous Paint: Cold-applied asphalt mastic paint complying with SSPC-Paint 12, except containing no asbestos, and formulated for 30-mil thickness per coat.

2.2 GLAZING MATERIALS

- A. Glass: As specified in Division 8 Section "Glazing."
- B. Glazing Gaskets: Manufacturer's standard pressure-glazing gaskets of elastomer type and hardness selected by skylight and gasket manufacturers to comply with requirements. Provide gasket assemblies that have corners sealed with sealant recommended by gasket manufacturer.
- C. Spacers, Edge Blocks, and Setting Blocks: Manufacturer's standard permanent nonmigrating type of elastomer type and hardness selected to comply with requirements.
- D. Weatherseal Sealant: Neutral-curing silicone sealant recommended by skylight and sealant manufacturers for this use.
 1. Sealant is capable of withstanding 50 percent movement in both extension and compression (total of 100 percent movement) when tested for adhesion and cohesion under maximum cyclic movement according to ASTM C 719.
 2. Sealant complies with ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and, as applicable to substrates including other sealants with which it comes in contact, O.
 3. Color: Black.

2.3 FABRICATION

- A. Framing Components: As follows:
 - 1. Fabricate components that, when assembled, will have accurately fitted joints with ends coped or mitered to produce hairline joints free of burrs and distortion.
 - 2. Fabricate components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
 - 3. Fabricate components to accommodate expansion, contraction, and field adjustment, and to provide for minimum clearance and shimming at skylight perimeter.
 - 4. Fabricate components to ensure that glazing is thermally and physically isolated from framing members.
 - 5. Form shapes with sharp profiles, straight and free of defects or deformations, before finishing.
 - 6. Fit and assemble components to greatest extent practicable before finishing.
 - 7. Fit and secure joints with screw and spline, internal reinforcement, or welding.
 - 8. Reinforce members as required to retain fastener threads.
 - 9. Where fasteners are exposed to view from interior, countersink bolt or screw heads and finish to match framing.
 - 10. Weld components before finishing and in concealed locations to greatest extent practicable to minimize distortion.
 - 11. Before shipping, shop assemble, mark, and disassemble components that cannot be permanently shop assembled.
- B. Provide continuous aluminum curb with weatherproof expansion joints and locked and sealed or fully welded corners. Locate weep holes in the curb at each rafter connection to drain condensation.
- C. Prepare framing to receive anchor and connection devices and fasteners.
- D. Metal Protection: As follows:
 - 1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
 - 2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
 - 3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

2.4 ALUMINUM FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Exposed Aluminum Surfaces:
 - 1. High Performance Organic Coating Finish: Comply with AA-C12-C42-R1x, prepare, pretreat and apply coating as specified below to comply with manufacturer's written instructions
 - 2. Fluoropolymer 3-Coat Coating System: Manufacturer's standard 3-coat thermocured system of primer and fluoropolymer color coat and clear fluorocarbon topcoat with both color coat and clear topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight, complying with AAMA 2605, (similar to Hylar 5000 or Kynar 500).
 - a. Custom color as selected by Architect.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine roof and adjacent construction and conditions under which skylights will be installed. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Metal Protection: As follows:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.
3. Where aluminum will contact pressure-treated wood, separate dissimilar materials by methods recommended by manufacturer.

3.3 INSTALLATION

- A. General: Comply with manufacturer's written instructions for protecting, handling, and installing skylight components.
 1. Fit frame joints to produce hairline joints free of burrs and distortion.
 2. Rigidly secure nonmovement joints.
 3. Accommodate thermal and mechanical movements.
 4. Install framing components to drain water passing joints and to drain condensation and moisture occurring or migrating within skylight system to the exterior.
 5. Coordinate installation of insulation and flashings at skylight perimeters to maintain continuity of thermal and water barriers.
 6. Set continuous curbs and flashings in a full sealant bed, unless otherwise indicated. Comply with requirements in Division 7 Section "Joint Sealants."
- B. Glass and Glazing: Install in accordance with requirements of Section 088000 - Glazing.
- C. Erection Tolerances: Install skylight components true in plane, accurately aligned, and without warp or rack. Adjust framing to comply with following tolerances:
 1. Variation from Plane: Limit variation from plane or location shown to 1/8 inch in 10 feet; 1/4 inch over total length.
 2. Alignment: Where surfaces abut in line and at corners and where surfaces are separated by less than 3 inches, limit offset from true alignment to less than 1/32 inch; otherwise, limit offset from true alignment to 1/8 inch.

3.4 CLEANING

- A. Clean skylights inside and outside, immediately after installation and after sealants have cured, according to manufacturer's written recommendations.
 1. Remove temporary protective coverings and strippable coatings from prefinished metal surfaces. Remove labels and markings from all components.
- B. Remove excess sealant according to sealant manufacturer's written recommendations.

END OF SECTION

SECTION 088000 GLAZING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Monolithic laminated vision glass.
 - 2. Insulated vision glass.
 - a. Insulated laminated glass
 - 3. Fire-rated security glazing.
 - 4. Accessories, glazing and setting materials.
 - 5. Self-adhered decorative film on clear glass.
- B. Related Sections:
 - 1. Section 079000 – Joint Protection.
 - 2. Section 085113 - Aluminum Windows: Glass in aluminum window system.
 - 3. Section 086300 – Metal-Framed Skylights: Glass and glazing in skylights.
 - 4. Section 084400 – Aluminum Curtain Walls, Windows and Entrances: Glass and glazing in curtain wall, window and entrance system.
 - 5. Section 102813 – Toilet Accessories: Metal-framed mirror units.

1.2 DEFINITIONS

- A. Manufacturer: A firm that produces primary glass or fabricated glass as defined in referenced glazing publications.
- B. Interspace: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
- C. Deterioration of Laminated Glass: Defects developed from normal use attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
- D. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thicknesses indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites for various size openings in nominal thicknesses indicated, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:
 - 1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour at 33 feet above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.4.2, "Analytic Procedure," based on mean roof heights above grade indicated on Drawings.
 - b. Specified Design Seismic Loads: Determine design seismic loads applicable to Project, required by ASCE 7.

- c. Specified Design Snow Loads: As indicated, but not less than snow loads applicable to Project, required by ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 7, "Snow Loads."
 - d. Probability of Breakage for Vertical Glazing: 8 lites per 1000 for lites set vertically or not more than 15 degrees off vertical and under wind action.
 - 1) Load Duration: 60 seconds or less.
 - e. Maximum Lateral Deflection: For the following types of glass supported on all four edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch, whichever is less.
 - 1) For insulating glass.
 - 2) For laminated-glass lites.
 - f. Minimum Glass Thickness for Exterior Lites: Not less than 6 mm.
 - g. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Seismic Movements: Glass in glazed curtain walls, glazed storefronts and glazed partitions shall meet relative displacement requirements to resist fallout as indicated in accordance with ASCE 7, Section 13.5.9.
- D. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
- 1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.
- E. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
- 1. For laminated-glass lites, properties are based on products of construction indicated.
 - 2. For insulating-glass units, properties are based on units with lites 6 mm thick and a nominal 1/2-inch- wide interspace.
 - 3. Center-of-Glass U-Values: NFRC 100 methodology using LBL-35298 WINDOW 4.1 computer program, expressed as Btu/ sq. ft. x h x deg F .
 - 4. Center-of-Glass Solar Heat Gain Coefficient: NFRC 200 methodology using LBL-35298 WINDOW 4.1 computer program.
 - 5. Solar Optical Properties: NFRC 300

1.4 APPLICABLE STANDARDS

- A. ASTM E 2190 Standard Specification for Insulating Glass Unit Performance and Evaluation Flat Glass: ASTM C 1036, Flat Glass. Flat Glass Marketing Association (FGMA) Glazing Manual.
- B. Heat Treated Flat Glass: ASTM C 1048, Heat Treated Flat Glass.
- C. Laminated Glass: ASTM C 1172 – Standard Specification for Laminated Architectural Flat Glass; Comply with applicable quality requirements for cut sizes of flat laminated glass consisting of two or more lites of glass bonded with interlayer material for use in building glazing.

1.5 SUBMITTALS

- A. Product Data: Provide for structural, physical and environmental characteristics, size limitations, special handling or installation requirements.
- B. Shop Drawings:
 - 1. Review curtain wall and window shop drawings and submit acceptance of details as suitable for proposed glass products.
- C. Calculations: Structural design shall be performed by a Professional Engineer, licensed in the state where Project is located. Signed engineering calculations shall be submitted to Architect/Engineer

1. Structural design calculations are required per IBC Section 2403, for glass not supported on 4 sides, including glass supports and framing, indicating structural integrity of glass size, glass support members, anchors, fasteners and connections to building, in accordance with specified criteria.
 2. Structural design calculations for seismic design forces and relative displacements are required for glass in glazed curtain walls, glazed storefronts and glazed partitions in accordance with Section 017325.
 3. Engineering Responsibility: Calculations shall be reviewed for stated design assumptions, general compliance to specified requirements, and forces imposed on glass structure. The accuracy of the design calculations shall be the sole responsibility of the Contractor's Professional Engineer.
- D. Samples: Submit samples of glazing sealant, for color selection and appearance acceptance.
- E. Insulating Glass Certification: Submit data verifying compliance with IGCC, Class A level.
- F. Compatibility Certification: After testing and review, certify compatibility of materials in contact and in close proximity to glazing sealant materials.
- G. Wind Pressure and Thermal Stress Analysis: Submit thermal stress analysis of glass where thermal stress may occur.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).
- B. Elastomeric Glazing Sealant Product Testing: Obtain sealant test results for product test reports in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period.
1. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.
 2. Test elastomeric glazing sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.
- C. Single Source Responsibility: Provide materials obtained from one source for each type of insulating glass and glazing product indicated.
- D. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252
- E. Fire-Rated Window Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 257.
- F. Safety Glass: Category II materials complying with testing requirements in 16 CFR 1201 and ANSI Z97.1.
1. Subject to compliance with requirements, permanently mark safety glass with certification label of Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.
- G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the following inspecting and testing agency:
1. Insulating Glass Certification Council.
- H. Mockups: Before glazing, build mockups for each glass product indicated below to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution. Build mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in the combination with curtain wall mockup requirements.
2. Build mockups with the glass to match glazing systems required for Project, including typical lite size, framing systems, and glazing methods:
3. Notify Architect seven days in advance of dates and times when mockups will be constructed.
4. Obtain Architect's approval of mockups before starting fabrication.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed.

1.7 PRODUCT HANDLING

- A. Deliver and store glass and glazing in manufacturer's protective covering. Handle glass and glazing with care to prevent damage.

1.8 PROJECT/SITE CONDITIONS

- A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
 1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.9 GLASS WARRANTY

- A. Warranty for Insulating Units: Warranty sealed insulating glass units for minimum period of ten (10) years, with manufacturer's replacement guarantee, covering as minimum: Defective or failure of seal; material vision obstruction as result of dust collection or film formation between panels or other similar failure and the following specific conditions:
 1. In addition to replacement of insulated units, provide removal and reinstallation of new units without cost to Owner during first five (5) years of guarantee.
- B. Laminated Glass Warranty: Laminated glass that delaminates shall be replaced at no charge (material only) for minimum 5 years beginning on date of Substantial Completion.
- C. Glazing installer shall coordinate glass and glazing installation with framing systems, and install glass and glazing in accordance with manufacturer's instructions, so that guarantee is maintained.

PART 2 PRODUCTS

2.1 LAMINATED MONOLITHIC GLASS

- A. (GL-15) Laminated Clear Glass: 1/4 inch thick laminated glass, 2 layers of 1/8 inch clear glass laminated with 0.030 inch clear PVB inner layer. Edges ground smooth for exposed conditions.

2.2 INSULATING GLASS

- A. (GL-21) Clear Low-E Insulated Glass Unit: One inch thick unit constructed of 1/4 inch clear exterior light, 1/2 inch air space using fabricators warm edge spacer, and 1/4 inch clear interior. High performance low-emissivity coating on No. 2 surface and argon gas in cavities. Glass thickness and thickness of individual glass plies are minimum. One or both plies heat strengthened where required for wind pressure or thermal stress.
 1. Visible transmittance: 62 percent.
 2. Solar energy transmittance: 24 percent.
 3. U-V transmittance: 5 percent.
 4. Visible light reflectance – exterior: 10 percent.
 5. Visible light reflectance – interior: 10 percent.
 6. Solar energy reflectance: 37 percent.
 7. Nighttime Winter U-value: 0.29 BTU/hour/square foot maximum.
 8. Nighttime Summer U-value: 0.26 BTU/hour/square foot maximum.
 9. Shading coefficient: 0.33
 10. Relative heat gain: 70 BTU/hour/square foot maximum.

11. Solar heat gain coefficient: 0.29
12. LSG: 2.14

B. (GL-21T) Clear Tempered, Low-E Insulated Glass Unit: One inch thick unit constructed of 1/4 inch clear tempered exterior light, 1/2 inch air space using fabricators warm edge spacer, and 1/4 inch clear tempered interior light. Low-emissivity coating on No. 2 surface and argon gas in cavity. Glass thickness and thickness of individual glass plies are minimum.

1. Visible transmittance: 62 percent.
2. Solar energy transmittance: 24 percent.
3. U-V transmittance: 5 percent.
4. Visible light reflectance – exterior: 10 percent.
5. Visible light reflectance – interior: 10 percent.
6. Solar energy reflectance: 37 percent.
7. Nighttime Winter U-value: 0.29 BTU/hour/square foot maximum.
8. Nighttime Summer U-value: 0.26 BTU/hour/square foot maximum.
9. Shading coefficient: 0.33
10. Relative heat gain: 70 BTU/hour/square foot maximum.
11. Solar heat gain coefficient: 0.29
12. LSG: 2.14

2.3 INSULATED LAMINATED GLASS

A. (GL-31) Insulated Glass Units: 1-1/16 inch thick laminated, insulated, low-e coated glass unit, 1/4 inch clear heat strengthened outboard light (unless tempered is required for wind pressure or thermal stress), 1/2 inch air space using fabricators warm edge spacer, 2 layers of 1/8 inch clear heat strengthened inboard light laminated with 0.060 inch clear PVB inner layer.

1. Visible transmittance: 39 percent.
2. Outside reflectance: 11 percent maximum.
3. Nighttime winter U-value: 0.29 BTU/hour/square foot maximum.
4. Relative heat gain: BTU/hour/square foot maximum.

2.4 FIRE-RATED SECURITY GLAZING

A. Fire Resistive Security Glass: SuperSecure™ 11-XLS 45-120 minute fire resistive security glazing as manufactured and distributed by SAFTI FIRST.

1. Fire Rating: Must be fire rated from 45-120 minutes with hose stream and meet ASTM E-119.
2. CDCR Forced Entry Rating: Must have CDCR 860-09a testing requirements.
3. ASTM F1915 Grade: Must meet Grade 1-4 per ASTM F1915.
4. Impact Safety Resistance: CPSC 16 CFR 1201 Cat. I & II.
5. Glazing materials installed in Hazardous Locations, subject to human impact, shall be certified and permanently labeled as meeting applicable requirements reference in NFPA 80:
 - a. CPSC 16 CFR 1201 Cat. I & II

B. Glazing shall be installed in an equally rated framing system.

2.5 DECORATIVE FILM

A. (FLM): Self-adhering window film. Refer to Material Identification Codes.

2.6 ACCESSORIES

- A. Setting Blocks: 100% silicone with a durometer hardness of 85±5, chemically compatible with glazing sealant or compound, length as recommended by glass manufacturer.
- B. Spacers and Shims: 100% silicone with a durometer hardness of 85±5, chemically compatible with glazing sealant or compound, length as recommended by glass manufacturer.
- C. Glazing Tape: Butyl or silicone preshimmed tape similar to Tremco 440 Tape.

2.7 EXTERIOR GLAZING

- A. Glazing gaskets, sealant backers within glazing pockets, and continuous glass spacer pads at structural silicone shall be black heat cured silicone rubber conforming to ASTM C1115-00, Type C. Norton V2100 Thermalbond Tape is acceptable as a glass spacer pad when used in conjunction with structural silicone.
- B. Gaskets for dry glazed system shall be silicone, EPDM, neoprene or Santoprene. Sponge gaskets shall be extruded black neoprene with hardness of 40 +/- 5 durometer Shore A and conforming to ASTM C 509-00. Design sponge gaskets to provide 20% to 35% compression. Dense gaskets shall be black extrusions with Shore A hardness of 75 +/- 5 for hollow profiles and 60 +/- 5 for solid profiles, and conforming to ASTM C1115-00, Type C or to ASTM C 864-99. Injection mold corners of gaskets where compatible with installation procedures.
- C. Structural Glazing System:
 - 1. Sealant: GE Ultraglaze SSG 4000 by General Electric or 795 by Dow Corning. Verify compatibility of sealant with secondary seal of dual seal insulating glass system.
 - 2. Maximum design stress on Structural Silicone Sealant shall not exceed 20 ps

2.8 INTERIOR GLAZING

- A. Type and Manufacturer: Mono one-part acrylic-terpolymer sealant or Proglaze silicone sealant by Tremco, color as selected from manufacturers standard colors.
- B. Other Acceptable Manufacturers: General Electric, DAP, PTI, Pecora.
- C. Fire-Rated Glazing System: As recommended by fire-rated glass manufacturer.

2.9 FABRICATION

- A. Heat-Treated Float Glass: ASTM C 1048. Fabricate using horizontal roller heating process only. Roll wave distortion parallel to bottom edge of glass as installed. Deviation from flatness at any peak (peak to valley deviation): shall not exceed 0.003 inches in the center of a lite and shall not exceed 0.008 inches within 10.5 inches of the leading or trailing edge.
- B. Insulating Glass Units:
 - 1. Fabricate using both primary and secondary seals and as otherwise required to comply with the IGCC CBA classification.
 - 2. Fabricate using glass from the same manufacturer throughout the Project.
 - 3. Seal Construction: Dual seal design with primary seal of PIB and Silicone Secondary Seal, unless specifically indicated otherwise.
- A. Edge Finishing: Fabricate finished edges to produce smooth, polished edges without chips, scratches, or warps.
 - 1. Non-Exposed Finished Edge, Typical: Flat polished.
 - 2. Exposed Edges: Grind smooth and polish exposed glass edges and corners, unless noted otherwise.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper or timely completion.
 - 1. Verify glazing channels are free of burrs, irregularities, and debris.
 - 2. Verify glass is free of edge damage or face imperfections.
 - 3. Inspect door and frames to determine that frames, sash, and stops are set true and straight. Sash rabbets and stops shall be clean and dry at time of glazing.
 - 4. Do not proceed until unsatisfactory conditions have been corrected.
- B. Beginning of installation means acceptance of substrate.

3.2 PREPARATION

- A. Provide glass manufacturer's recommended edge clearances when sizing glass.
- B. Remove protective coatings from surfaces to be glazed.
- C. Clean glass and glazing surfaces to remove dust, oil, and contaminants, and wipe dry.
- D. Verify measurements of sash and openings at Project.
 - 1. Dimensions shown or indicated are given only as a guide for estimating purposes, and actual size shall be determined by measurement of the actual openings. Accurately cut glass to fit openings with proper clearances and setting block height.
- E. Coordinate with and check Shop Drawings furnished by other suppliers of Work affecting this Section to avoid field installation problems.
- F. Before glazing metal sash, remove oil, lacquer, or other material to which the compound will not readily adhere or which will tend to delaminate from metal and cause a leak through the glazing seal.

3.3 INSTALLATION

- A. Comply with glass fabricators recommendations.
- B. Except where curtain wall, window, entrance or glass manufacturer recommends otherwise, comply with Flat Glass Marketing Association (FGMA) Sealant Manual and FGMA Glazing Manual.
- C. Glaze insulated units as recommended by glass and frame manufacturers.
- D. Do not apply glazing materials at temperatures below manufacturer's recommendations or to damp or frosted surfaces. Apply glazing material according to the manufacturer's instructions using proper primers as required.
- E. Set glass using neoprene setting blocks and spacers to insure proper edge clearance and uniform beads of compound. Clearances shall conform to FGMA Glazing Manual requirements. Center glass in glazing rabbets.
- F. Check openings to confirm proper clearance at perimeters and between glass and stops.
 - 1. Clean surfaces of rabbet (including stops) and surface of glass which will come into contact with sealant. Use solvents and methods which insure clean, dry surfaces without film or foreign material when sealant is placed.
- G. Remove and replace glazing beads carefully to avoid marking or defacing any portion of frame, sash, or fastenings.
 - 1. Set glass in full bed of glazing tape or sealant. Clean glazing material after stops are installed. Clean excess compound, etc. from glass after setting in conformance with glass manufacturer's recommendations.
 - 2. If recommended prime surfaces prior to glazing.
- H. Set glass with reams (waves) running horizontally. Set glass with factory attached labels in place.
- I. Setting Blocks: Place setting blocks at locations recommended by glass manufacturer, generally between 1/4 points and 6 inches from corner, except at glazed doors.
 - 1. At glazed doors, provide one block at sill, located 3 inches up from edge of glass at hinge side; one block at hinge side jamb, located 3 inches up from lower edge of glass; one block at head, located 3 inches from edge of glass at latch side of door; and, one block at jamb at lock side of door, located 3 inches down from edge of glass at top corner.
 - 2. Use blocks of length required to properly support glass. Offset approximately 1 inch from shims.
- J. Glass Installation in Steel (Hollow Metal) Frames:
 - 1. Glaze frames using pre-shimmed tape on both sides. Firmly glaze in place with joints sealed, free of rattles.
 - 2. Set glass on setting blocks with a full bed of sealant or glazing tape.
- K. Glass Installation in Aluminum Frames:

1. Glaze aluminum frames using preformed EPDM elastomeric glazing extrusion separately or in combination with sealant and pre-shimmed glazing tape in compliance with aluminum frame supplier's recommendations.
 2. Set glass on setting blocks as recommended by manufacturer.
 3. Apply tape and/or sealant to produce uniform sight line even with frame.
 4. Set glass in gaskets with corners sealed.
- L. Glazing Sealant: Along entire bottom edge of light, and up at least 6 inches at each jamb, gun in continuous full bed of sealant to fill voids.
1. Fill entire space, full width of pane, full depth of glass, with sufficient sealant to form heel along inside face and edge of glass.
 2. At other edges (top and sides) gun in continuous heel bead of sealant along edges of glass perimeter to set stop against and into, acting as fill between glass and stop.
 3. Immediately after setting glass, at entire perimeter of glass, gun in sealant between stop and glass so space above spacer is completely filled, without voids.
 4. Place sealant flush with daylight edge of stops, with slight watershed at exterior. Provide straight, smooth surface meeting at opening corners with sharp intersection.
 5. Leave no sealant on exposed surfaces of stops and glass.
- M. Apply structural sealant carefully in uniform thickness pushing bead ahead of nozzle and making sure that entire cavity is filled. Air pockets or voids along edges are not acceptable.
1. Tool joint immediately after application.
 2. Tool neatly, forcing sealant into contact with joint sides, eliminating internal voids and insuring good substrate contact.
 3. Do not tool with soap or detergent solutions.
- N. Apply self-adhering decorative film to clean glass surface according to manufacturer instructions.
- 3.4 CLEANING**
- A. Remove surplus materials.
 - B. Final cleaning of glass by Contractor.

END OF SECTION

SECTION 089100 LOUVERS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Shop fabricated louvers and frames.
 - 2. Head and sill flashing to adjacent work.
 - 3. Bird screening.
 - 4. Attachment hardware.
- B. Related Sections:
 - 1. Section 055000 - Metal Fabrications: Steel support framing.
 - 2. Division 23 - Mechanical: Attachment of ducting and blanking out unused louver area.

1.2 REFERENCES

- A. SMACNA "Architectural Sheet Metal Manual" recommendations for fabrication, construction details and installation procedures.

1.3 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300. Clearly indicate, in large scale, profile of frame and installation details, relation to adjacent construction, flashing, blade configuration, connections to duct work, bird screens, and percentage of free air opening.
- B. Samples: Submit samples of metal wall louver finish in accordance with Section 013300.

1.4 QUALITY ASSURANCE

- A. General: Design and fabricate exterior wall louvers in accordance with AMCA Standard 500 and comply with AMCA Certified Ratings Program.
- B. Free Area, Exterior Wall Louvers: Not less than 40 percent free area.
- C. Water Penetration, Exterior Wall Louvers: Zero water penetration at 700 FPM through louver free area.
- D. Air Pressure Drop, Exterior Wall Louvers: Not more than 0.10 inch of Water Gauge at 1000 FPM through louver free area.
- E. SMACNA Standard: Comply with SMACNA Architectural Sheet Metal Manual recommendations for fabrication, construction details, and installation procedures.

1.5 PROTECTION

- A. Protect louvers and finishes from damage during delivery and installation.
- B. Protect adjacent surfaces, finishes and materials from damage during installation of louvers.

PART 2 PRODUCTS

2.1 LOUVERS

- A. Type: Extruded aluminum louvers.

2.2 MATERIALS

- A. Aluminum: Extruded, ASTM B221, alloy and strength as required for intended use.

2.3 FABRICATION

- A. Aluminum Louvers (LVR): Extruded, 4 inch deep, minimum 0.081 inch thick with reinforcing bosses, integral water stop fastened with stainless steel screws to extruded aluminum channel shape frame minimum 0.081 inch thick to provide rigid and square self-supporting unit with fixed blades at 45 degree slope, with free area as specified.
- B. Bird Screen: 0.063 inch diameter aluminum wire 1/2 inch interwoven square mesh in aluminum frame.
- C. Accessories: Recessed mullions, sill extensions, flashings, wall anchors, structural supplementary sub-framing.

2.4 FINISHES

- A. Aluminum: PVDF fluorocarbon coating, minimum 70 percent PVDF.
- B. Colors: As selected by Architect from manufacturer's standard range.

PART 3 EXECUTION

3.1 PREPARATION

- A. Take site dimensions affecting this work.
- B. Ensure openings affecting this work are properly prepared and that flashings are correctly located to divert moisture to exterior.

3.2 INSTALLATION

- A. Install louvers in openings properly aligned and level.
- B. Secure louvers rigid with concealed fasteners of noncorrosive metals to suit materials as being encountered.
- C. Coordinate installation method with application of wall system and mechanical work.
- D. Set and tie in to flashings to ensure diversion of moisture to exterior.
- E. Install bird screens fixed to interior.

3.3 CLEANING

- A. Periodically clean exposed surfaces of louvers, which are not protected by temporary covering, to remove fingerprints and soil during construction period; do not let soil accumulate until final cleaning.
- B. Before final inspection, clean exposed surfaces with water and mild soap or detergent not harmful to finishes. Rinse thoroughly and dry surface.

END OF SECTION

SECTION 092216 NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Non-load-bearing metal framing systems for interior assemblies, including:
 - a. Interior partitions.
 - b. Interior suspended ceiling and soffit systems.
 - c. Shaft wall systems.
- B. Related Sections:
 - 1. Section 050000 – Division 05 -Metals: For exterior steel stud framing assemblies and for interior framing members carrying a lateral (transverse) load exceeding 10 lbs/ft², a superimposed vertical load exceeding 100 lbs/ft, or a superimposed vertical load exceeding 200 lbs; and members exceeding maximum heights, spans or spacing for non-structural framing as indicated in ASTM C 754 Tables 1-7.
 - 2. Section 055000 - Metal Fabrications.
 - 3. Section 079000 - Joint Protection.
 - 4. Section 092900 - Gypsum Board.

1.2 SUBMITTALS

- A. Product Data: Submit required product data and documentation in accordance with Section 013300:
 - 1. Submit statement indicating that metal stud manufacturer has reviewed Project documents and that framing supplied conforms to specified requirements.
 - 2. Evaluation Reports: ICC-ES reports for metal studs and tracks, indicating compliance with specified requirements and building code in effect.
- B. EQ Stud Submittals: Comply with the following if submitting EQ studs.
 - 1. Submit statement indicating that metal stud manufacturer has reviewed Project documents and that framing supplied conforms to specified requirements.
 - 2. Submit list of completed projects of similar project type and similar wall loading where specific product recommended has been used.
 - 3. Submit material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
 - 4. Evaluation Reports: ICC-ES reports for metal studs and tracks, indicating compliance with specified requirements and building code in effect.
- C. Shop Drawings: Submit in accordance with Section 013300, indicating light gauge framing system. Indicate by plan and elevation, stud framing (spacing, sizes, thicknesses and types), openings, bracing and blocking, fastening and anchorage, strapping, bridging, connection details and reinforcement.
- D. Seismic Design Calculations: Structural design shall be performed by a Professional Engineer, licensed in the state where Project is located, indicating structural integrity of members, anchors, fasteners and connections to building structure. Submit signed engineering calculations concurrently with the shop drawings to Architect/Engineer upon request.
 - 1. Engineering Responsibility: Calculations shall be reviewed for stated design assumptions, general compliance to specified requirements, and forces imposed on structure. The accuracy of the design calculations shall be the sole responsibility of the Contractor's Professional Engineer

1.3 QUALITY ASSURANCE

- A. Perform work in accordance with applicable reference standards unless otherwise indicated.

- B. Pre-Installation Conference: Convene a pre-installation meeting at the beginning of the project to review acoustically-rated construction requirements and to coordinate penetrations.
1. Architect, Contractor, Owner's representative and each trade that may need to penetrate acoustically rated construction or will be involved in construction of acoustically rated partitions and related systems must attend.
 2. Review layouts and routing for potential penetrating items, discuss reducing or eliminating penetrating items by considering alternate routing, review construction requirements, details and specifications for acoustically rated construction.
 3. A follow-up meeting should be scheduled as needed.
 4. This meeting can occur in conjunction with a regular construction progress meeting.
 5. Publish meeting minutes highlighting topics discussed, actions items and decision made.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing metal framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.
- C. Shaft Wall Assemblies: Provide stud shaft wall system designed and tested by manufacturer to withstand lateral loading (air pressure) of 10 lbs per sq ft for maximum wall height required, and with deflection limited to 1/240 of partition height. (Refer to Section 092900 - Gypsum Board for shaft wall construction).
- D. Seismic Design Requirements: Design all metal framing systems to withstand out-of-plane seismic design forces and to accommodate seismic relative displacements. Seismic design forces shall be based on the weight of the partition framing, finishes, soffits, connected casework or equipment, and ceilings for which it provides bracing. Out-of-plane seismic design force shall not be less than 5 psf.

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
1. Provide framing type, weight, grade and finish of materials in accordance with Manufacturer's recommendations, except where otherwise required by governing regulations and applicable standards.
 2. Provide clips, fasteners, ties, reinforcing, flat strap and backing plates, stiffeners, shoes, tracks, hangers, brackets, anchors, accessories, and trim as recommended by Manufacturer for application indicated.
 3. Steel Sheet Components: ASTM C 645, fabricated of steel meeting requirements of ASTM A1003.
 4. Protective Coating (Minimum): ASTM A653, G40 hot-dip galvanized zinc coating or coating with G40 equivalent corrosion resistance.
- B. (MET STUD-1) Metal Studs and Runners: ASTM C645, and meeting or exceeding flexural strength, allowable bending moment, and screw pull-out of a standard 33 mil thick stud.
- C. (MET STUD-2) Shaft Wall Metal Studs: ASTM C645, steel C-H, C-T or I studs hot-dipped galvanized.
- D. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
- E. Firestop Track: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.

- F. Galvanized Flat Strap and Backing Plate at Interior Stud Walls: Steel sheet for blocking and bracing in length and width indicated.
 - 1. Minimum Base-Metal Thicknesses:
 - a. Typical: 0.054 inch.
 - b. For Heavy Equipment and Grab Bar Locations: 0.068 inch.
 - 2. Where Wood Backing and Blocking is Indicated: Refer to Section 061000 for wood requirements. Provide fire-resistant treatment.

2.3 SUSPENSION SYSTEMS

- A. Components, General: Comply with ASTM C754 for conditions indicated.
- B. Furring Channels: As specified above.
- C. Tie Wire: ASTM A641, Class 1 zinc coating, soft temper, 0.0625 inch diameter wire, or double strand of 0.0475 inch diameter wire.
- D. Wire Hangers: ASTM A641, Class 1 zinc coating, soft temper, 0.162 inch diameter.
- E. Manufactured Suspension Grid System for Ceilings and Soffits: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.

2.4 AUXILIARY COMPONENTS

- A. Fasteners: Galvanized steel fasteners of type, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates; and of length suitable for adequate penetration of substrate
- B. Asphalt Protection Strips: Strip of 15 lb. asphalt saturated felt at intersection of partitions and masonry walls.
- C. Isolation Strip: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.
- D. Acoustic Sealant: In accordance with Section 092900 - Gypsum Board.
- E. Partition-To-Curtain Wall Closure Assembly: Provide field-built closure assemblies where partitions abut curtain wall mullions or glazing, as shown on Drawings. Provide units capable of accommodating variations in adjacent surfaces, and allowing for thermal movements from ambient and surface temperature changes.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION, GENERAL

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

- D. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch from plane formed by faces of adjacent framing.

3.3 FRAMING INSTALLATION

A. Framing Installation, General:

1. Partition Heights: Extend partition stud system through suspended ceilings to structural support above, except where indicated to terminate at ceiling.
 - a. Provide additional bracing for partitions extending above ceiling where indicated.
 - b. Continue framing around ducts penetrating partitions above ceiling.
2. Coordinate erection of studs with installation of service utilities. Align stud web openings. Coordinate installation of bucks, anchors, blocking, electrical and mechanical work which is to be placed in or behind partition framing. Allow such items to be installed after framing is complete.
3. Isolate stud system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned joints to attain lateral support and avoid axial loading.
4. Reinforce stud partitions and provide additional metal studs as indicated and required for installation of wall cabinets, wall mounted equipment, wall mounted mechanical and electrical fixtures, accessories, shelves and shelf standards. Provide thick steel plate to span minimum of 3 studs for installation of mirrors, toilet accessories or grab bars.
5. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
6. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

B. Runners and Tracks: Secure runner tracks to floor and ceiling construction, and to structure above ceilings as recommended by manufacturer, with fastener spacing not to exceed 24 inches o.c.

1. Runner Tracks: Provide continuous track sized to match studs. Align runner tracks accurately to partition layout at both floor and ceiling. Provide fasteners at corners and ends of runner tracks.
2. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
3. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
4. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

C. Metal Studs: Install studs vertically at 16 inches o.c., unless otherwise indicated, and not more than 2 inches from abutting construction, each side of openings, and at corners.

1. Install metal studs in floor and ceiling runner tracks. Secure studs to runners. Anchor light gauge screw-type partition studs to runner tracks by screwing opposite flanges top and bottom, except screw end studs to both tracks at both flanges.
2. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
3. Provide additional studs at exterior corners and 2 inches from inside corners, terminations of partitions, and both sides of control joints.
4. Where partitions abut other construction, provide vertical runner track securely attached to construction.
5. Use full length studs between runner tracks.
6. Stud Splicing: Not permitted.

D. Door Openings:

1. Frame door openings with vertical studs attached to each jamb of door frame.
2. Provide additional studs 2 inches from jamb studs.
3. Frame head of door with horizontal section of runner track attached to jamb studs and provide vertical studs cut to fit between head and ceiling tracks and attach to tracks.
4. Fit runners under and above openings, secure intermediate studs at spacing of wall studs. Brace stud framing system and make rigid.

- E. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

3.4 SHAFT WALL INSTALLATION

- A. Shaft Wall Installation, General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.
 - 1. Anchor components to comply with ratings and performance requirements, and with governing regulations.
 - 2. Isolate shaft system from transfer of structural loading to system, both horizontally and vertically. Provide slip or cushioned type joints to attain lateral support and avoid axial loading.
 - 3. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.
- B. Supplementary Framing: Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
- C. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.
- D. Sprayed Fire-Resistive Materials: Coordinate gypsum board shaft system work with sprayed-on fireproofing of structure, so that both remain complete and undamaged. Patch or replace sprayed-on fireproofing removed or damaged during installation of shaft framing system.

3.5 SUSPENSION SYSTEM INSTALLATION

- A. Suspended Assemblies, General: ASTM C 754.
 - 1. Install ceiling framing independent of walls, columns, and above ceiling work.
 - 2. Do not bridge building expansion joints with support system.
 - 3. Installation Tolerances: Install steel framing components for suspended ceilings so members for panel attachment are level to within 1/8 inch in 12 feet measured lengthwise on each member transversely between parallel members.
- B. Hangers: Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 1. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - a. Space hanger wires 48 inches o.c. along carrying channels and within 6 inches of ends of channel run. Anchor hanger wires to supporting structure. Do not attach hangers to metal deck tabs.
 - 2. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 3. Coordinate location of hangers with other work.
 - a. Do not attach hangers to steel roof deck.
 - b. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- C. Carrying Channels: Position channels at proper height and level, and secure with hanger wires.
 - 1. Space main carrying channels at maximum 48 inches on center, not more than 6 inches from perimeter walls.
 - 2. Lap splices minimum 12 inches and secure together 2 inches from each end of splice. Provide clearance between channels and abutting walls or partitions.

- D. Furring Channels: Comply with Gypsum Association GA-203.
 - 1. Place furring channels perpendicular to carrying channels at 16 inches on center not more than 6 inches from perimeter walls.
 - 2. Lap splices minimum 8 inches and secure together one inch from each end of splice.
 - 3. Provide clearance between furring and abutting walls or partitions. Secure furring to carrying channels with clips.
 - 4. Frame both sides of joints with furring and other supports.
 - 5. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Lateral Bracing: Laterally brace entire suspension system where required. Reinforce openings in ceiling suspension system which interrupt main carrying channels or furring channels, with lateral channel bracing. Extend bracing minimum 24 inches past each end of openings.

3.6 GRID SUSPENSION SYSTEM INSTALLATION

- A. Suspension Grid Systems: Install in accordance with Manufacturer's instructions.
 - 1. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces.
 - 2. Install main beams and cross tees at the on center spacing required for ceiling loading, and location of in-ceiling services.
 - 3. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
 - 4. Provide additional bracing as required by code.
- B. Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces.
- C. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

END OF SECTION

SECTION 092900 GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Gypsum board panels
2. Shaft wall panels.
3. Tile backer board.
4. Impact resistant board.
5. Mold and abuse resistant board.
6. Board accessories, corner reinforcement, casing beads, control joints.
7. Fasteners, screws and adhesive, wallboard sealant.
8. Gypsum board treatment of joints, corners, metal trim flanges and fasteners.
9. Acoustical insulation, sealant and installation requirements for acoustical gypsum board systems.

B. Related Sections:

1. Section 061000 - Rough Carpentry: Wood blocking.
2. Section 072100 - Thermal Insulation.
3. Section 079000 - Joint Protection: Other sealants.
4. Section 081113 - Hollow Metal Doors and Frames.
5. Section 083100 - Access Doors and Panels.
6. Section 092216 - Non-Structural Metal Framing: Metal studs for interior non-load bearing gypsum board partitioning.
7. Section 099000 – Painting.

1.2 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.3 PERFORMANCE REQUIREMENTS

- A. Shaft Wall Performance Requirements: Provide gypsum board shaft wall system design and tested by manufacturer to withstand lateral loading (air pressure) of 10 lbs per sq ft for maximum wall height required, and with deflection limited to 1/240.
1. Refer to Section 092200 – Gypsum Board Supports for shaft wall studs.
- B. Acoustic Rated Construction: Meet requirements of GA-600 design manual and referenced acoustic rated system.

1.4 SUBMITTALS

- A. Product Data: Submit Manufacturer's recommended specifications and requirements for gypsum board products and accessories, including control joint placement location at walls and ceilings.

1.5 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.
1. Fire-Resistance-Rated Assemblies: Indicated by design designations from UL's "Fire Resistance Directory." GA-600, "Fire Resistance Design Manual."

- B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by a qualified independent testing agency.
 - 1. STC-Rated Assemblies: Indicated by design designations from GA-600, "Fire Resistance Design Manual."
- C. Keep copy of GA 216 and Levels of Gypsum Board Finish in field office for duration of project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver drywall system components and materials in sealed containers and bundles, fully identified with manufacturer's name, brand, type and grade; store in dry, well ventilated space, protected from weather, under cover and off ground.
- B. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with requirements of referenced gypsum board application standards and recommendations of gypsum board manufacturer, for environmental conditions before, during and after application of gypsum board.
- B. Cold Weather Protection: When ambient outdoor temperatures are below 55 degrees F maintain continuous, uniform, comfortable building working temperatures of not less than 55 degrees F for minimum period of 48 hours prior to, during and following application of gypsum board and joint treatment materials or bonding of adhesives.
- C. Ventilation: Ventilate building spaces as required to remove water in excess of that required for drying of joint treatment material immediately after its application. Avoid drafts during dry, hot weather to prevent too rapid drying.
- D. Control Joints: Provide control joints located not over 30 feet on center, regardless if control joints are indicated on drawings or not. Prior to commencing gypsum board work, verify location of control joints with Architect.

PART 2 PRODUCTS

2.1 GYPSUM PANEL PRODUCTS

- A. Gypsum board products not containing asbestos.
- B. Provide gypsum panel materials in accordance with recommendations of GA 216.
- C. Provide gypsum board of types indicated in maximum lengths and widths available to minimize end to end joints.
- D. Gypsum Wallboard:
 - 1. Gypsum Wall Board: ASTM C1396, made with 100 percent recycled and unbleached paper facings bonded without adhesives; gypsum core consisting of recycled or post-industrial flu-gas desulphurization (FSG) synthetic gypsum.
 - a. (GYP BD-1) Fire-rated Board: Type "X", 5/8 inch thickness.
 - b. (GYP BD-2) Fire-rated Mold and Water-resistant Board: 5/8 inch thick, Type "X", fire rated gypsum wallboard with water resistant paper face.
 - 1) Provide mold and water-resistant gypsum board as required by local building code and as indicated.
 - c. (GYP BD-21) Gypsum Shaft Liner: One inch thick shaft wall liner panel with moisture resistant paper facing. Square edges designed for installation into I, C-H, E, or H metal studs.

2.3 IMPACT RESISTANT GYPSUM PANELS

- A. (GYP BD-36) Very high impact-resistant gypsum fiber interior panel with embedded fiberglass mesh in back of panel, 5/8 inch thick.

2.4 ABUSE-RESISTANT AND MOLD RESISTANT GYPSUM PANELS

- A. (GYP BD-38) Abuse-Resistant and Mold-Resistant Gypsum Wallboard: ASTM C1396 and ASTM C1629 for abuse resistance, manufactured to produce greater resistance to surface indentation and through-penetration, along with providing extra protection against mold and mildew, than standard gypsum panels.
 - 1. Core: 5/8 inch, Type X.
 - 2. Long Edges: Tapered.
 - 3. Provide at inside face of exterior walls and interior partition walls throughout, unless noted otherwise.

2.5 INSULATION

- A. Insulation is required to be formaldehyde-free or GreenGuard Indoor Air Quality Certified.
- B. (INSUL-40) Acoustical Insulation- Fiberglass Batts: As required to meet requirements of UL Design, one of following materials: Man made vitreous fiber or resilient glass fibers bonded with thermo-setting resin with maximum flame-spread and smoke-developed indices of 25 and 50 per ASTM E 84, respectively; passing ASTM E 136 for combustion characteristics.
 - 1. Thickness: Same as stud depth or as indicated.
 - 2. Width of Batts: As required to meet UL requirements.
 - 3. ASTM C665, Type 1 (Unfaced).

2.6 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Corner Trim, Edge Trim, Inside Corner Trim for Abuse Resistant Gypsum Board:
 - 1. Provide fully bonded paper faced and joint tape backed copolymer tapered plastic trim at abuse resistant gypsum board.
 - 2. Provide corner trim as recommended by manufacturer for each condition.
- C. Joint Tape:
 - 1. Interior Gypsum Wallboard: Paper.
 - 2. Tile Backing Panels: As recommended by panel manufacturer.
- D. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use drying-type, all-purpose compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound, or high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat compound to produce Level 5 finish.

2.7 ACOUSTICAL SEALANT

- A. Products: Provide one of the following unless otherwise required to meet requirements of referenced STC rating. Provide low emitting sealants meeting SCQAMD rules.

- B. Acoustical Sealant for Exposed and Concealed Joints: Nonsag, paintable, nonstaining, latex sealant complying with ASTM C 834 and ASTM C 919 that effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
- C. Acoustical Sealant for Concealed Joints: Nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
- D. Provide moldable putty type products acceptable to meet or exceed STC rating at service boxes.

2.8 ACCESSORIES

- A. Fasteners and Anchorages: GA 216, USG Brand screws, type and size as recommended by wallboard manufacturer.
- B. Trim Accessories:
 - 1. Corner reinforcement.
 - 2. "J" metal trim.
 - 3. "L" metal trim.
- C. Control Joints: Control joint.
- D. Joint Treatment: Tape joint system.
- E. Metal Reveals and Trim: Large scale, extruded aluminum wall and ceiling trim profile as indicated.
 - 1. Profile: As shown on Material Identification Codes.
- F. Adhesive: As recommended by wallboard manufacturer for wood framing.
- G. Laminating Adhesive: Joint compound or adhesive as recommended by wallboard manufacturer for laminating gypsum board face layer to gypsum board base layer.
- H. Joint Sealant: As specified in Section 079000 - Joint Protection.

PART 3 EXECUTION

3.1 GYPSUM BOARD INSTALLATION

- A. Install and finish gypsum board and accessories in accordance with manufacturer's printed instructions and comply with recommendations of GA 216 and ASTM C840, including appendixes. Verify control joint locations at walls and ceilings with Architect.
- B. Minimize butt joints by using gypsum board of maximum length possible. If cut butt joints are unavoidable, locate end butt joints as far from center of walls or ceilings as possible and stagger not less than 12 inches in alternate courses of board.
- C. Do not install imperfect, damaged, damp or wet gypsum board.
- D. Butt boards together for light contact at edges or ends with not more than 1/16 inch open space between boards. Do not force into place.
- E. Locate edges and joints over supports or back-blocking except in horizontal applications. Position gypsum board so that both tapered edge joints and cut edges abut. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partition/walls.
 - 1. Form curved surfaces by carefully bending and fastening board to smooth even curve, free of flat or distorted areas and other imperfections. Comply with manufacturer's instructions for dampening of sheets or scoring of back face, if required to form to radius shown.
 - 2. Hold gypsum board 1/4 inch above floor at each type of partition.
- F. Install solid and semisolid drywall partitions made-up of coreboard or gypsum board studs with face courses of exposed gypsum board, laminated with both adhesive and screws.
- G. Isolate gypsum surfaces with control joints or other stress relief where:

1. Partition or furring abuts structural element (except floor) or dissimilar wall or ceiling.
 2. Ceiling abuts structural element, dissimilar wall or partition or other vertical penetration.
 3. Construction changes within plane of partition or ceiling.
 4. Partition or furring run exceeds 30 feet.
 5. Ceiling dimensions exceed 30 feet in either direction.
 6. Wings of "L", "U" and "T" shaped ceiling areas are joined.
 7. Expansion joints occur in exterior wall if expansion joints are not used.
 8. Where control joint is near a door opening, locate and align control joint with edge of door frame.
 - a. Ceiling height door frames may be used as control joints.
 - b. Where door frames are less than ceiling height, extend control joints to ceiling from both corners
 9. Review location of joints with Architect.
- H. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.
- I. Provide perimeter isolation where non-load-bearing partitions abut structural decks or ceilings, or vertical structural elements. Allow not less than 1/4 inch, or more than 1/2 inch gap between gypsum and structure. Finish edges of face layer with casing bead. Seal space between casing bead and structure with continuous acoustical sealant bead. Do not attach board directly to tracks.
- J. Cutting, Fitting and Trimming: Accurately measure and precut gypsum drywall units prior to installation. Make cuts from face side by scoring and snapping away from face side or by sawing. Completely cut paper on back face; do not break paper by tearing. Maintain close tolerances for accurate fit at joints between sheets and at framed openings, and allow for covering of edges of cut-outs with plates and escutcheons. Cut edges smooth as required for neat and accurate fit.
- K. Begin fastening from center portion of sheet and work toward edges and ends. Ensure contact of drywall with supports by applying pressure on surface adjacent to fastener being driven. Do not locate fasteners closer than 3/8 inch from edges or ends of sheets. Drive with shank approximately perpendicular to drywall surface.
- L. Drive screws with power screwdriver recommended by drywall manufacturer. Do not hammer drive screws. Set screw heads slightly below surface of drywall, but do not break or strip paper face around screw. Stagger screws on edges and ends of adjacent sheets.
- M. For fire-rated Walls: Fasten to metal framing and furring with screws. Comply with drywall manufacturer's instructions and UL requirements for fastening, but do not exceed 8 inches on center at perimeter and 12 inches on center spacing at the field. Space fasteners not less than 1/4 inch from edges and ends of gypsum drywall.
1. For Non-rated Walls: Fasten perimeter and field at 12 inches on center.
 2. For multilayer fire-rated walls: Comply with UL requirements.
 3. For Acoustical Walls: Comply with fire-rated wall UL requirements.
- N. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
- O. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.2 ACOUSTICALLY RATED PARTITIONS

- A. Where acoustically rated partitions are shown, provide complete air tight, acoustical rated assembly meeting or exceeding requirements of Sound Transmission Class (STC) ratings per manufacturer's requirements and GA 600 for sound control requirements.
- B. Do not penetrate acoustically rated partitions without authorization from Architect.
- C. Stagger joints between layers of gypsum board and install gypsum board to be continuous between adjacent rooms.
- D. Fit gypsum board tightly around structural elements.
- E. Install continuous acoustical sealant at:
 - 1. Entire perimeter of wall on each side of top, bottom and side of walls.
 - 2. Intersection at change of plane and change of material.
 - 3. Gaps between service outlets and gypsum board
 - 4. Each penetration.
 - 5. Structural elements.
- F. Seal entire back of service boxes.
- G. Seal gaps around penetrations as follows:
 - 1. One inch or less gap filled tightly with batt insulation and apply sealant.
 - 2. One inch or greater gap fill with acoustical insulation and moldable putty.

3.3 ACCESSORIES INSTALLATION

- A. Acoustical Insulation: Install blankets in accordance with manufacturer's printed instructions, with tight joints in blanket units. Use tape, adhesive or staples to hold blankets in place.
 - 1. Place acoustical insulation in partitions tight within spaces, around cut openings, behind and around electrical and mechanical items within or behind partitions and tight to items passing through partitions.
- B. Drywall Sealant: Seal perimeter of sound-rated partitions by filling open space between drywall and floor or ceiling construction with continuous bead of sealant. Fill open spaces between drywall and fixtures, cabinets and other flush or penetrating items with continuous bead of sealant. Seal sides and back of electrical boxes to completely close up openings and joints. Seal perimeter of wallboard shaft wall where it abuts other work.
 - 1. Apply joint sealant in accordance with Section 079000 - Joint Protection.
- C. Adhesive Application: Use adhesive recommended by manufacturer for type of substrate indicated. Prepare substrate and laminate wallboard in accordance with manufacturer's printed instructions. Provide temporary fasteners or bracing as recommended until adhesive sets.
- D. Reinforce external corners of drywall with metal corner bead. Securely fasten metal corner beads, edge trim casing beads and control joints.

3.4 SHAFT WALL INSTALLATION

- A. Anchor and fasten materials and components to comply with ratings and performance requirements, and to comply with governing regulations.
- B. Coordinate gypsum board shaft system work with sprayed-on fireproofing of structure, so that both remain complete and undamaged. Patch or replace sprayed-on fireproofing removed or damaged during installation of shaft system.
- C. Seal perimeter of each section of gypsum board shaft work where it abuts other work. Install second bead of acoustical sealant in location and manner which will prevent dislocation by air pressure differential between shaft and external spaces. Seal joints and penetrations in work; comply with manufacturer's instructions.

3.6 FINISHING

- A. Finish exposed drywall surfaces with joints, corners and exposed edges reinforced or trimmed and with joints, fastener heads, trim accessory flanges and surface defects filled with joint compound in accordance with drywall manufacturer's recommendations for smooth, flush surface. Form true, level or plumb lines, without joints, fastener heads, flanges of trim accessories or defects visible after application of field-applied decoration. Exposed metal trim (not filled) will not be acceptable.
- B. Use joint tape to reinforce joints formed by tapered edges or butt ends of drywall units and at interior corners and angles. Set tape in joint compound and apply skim coat over tape in one application. Do not use topping or finishing compounds for setting of tapes.
- C. Apply joint compound to joint. Apply joint compound to fill holes left from removal of screws at intermediate studs. Finish gypsum drywall thereafter, including sanding of final coat, in accordance with ASTM C840.
- D. Where open spaces of more than 1/16 inch width occur between abutting drywall units, except at control joints, prefill joints with joint compound and allow prefill to dry before application of joint tape.
- E. Finish Levels of Joints in Interior Gypsum Board Work:
 - 1. Level 0: No taping, finishing, or accessories required.
 - a. Use above suspended ceilings and within other concealed spaces, unless assembly is fire rated, sound rated, sound or smoke controlled, or unless space serves as air plenum.
 - 2. Level 1: At joints and interior angles embed tape in joint compound. Leave surface free of excess joint compound. Tool marks and ridges are acceptable.
 - 3. Level 2: At joints and interior angles embed tape in joint compound with one separate coat of joint compound applied over joints, angles, fastener heads, and accessories.
 - a. Use for mold and water resistant gypsum board indicated for use as a substrate for ceramic tile.
 - b. Use for gypsum board indicated for use as a substrate for wood paneling or acoustical panels.
 - c. Use above suspended ceilings and within other concealed spaces if gypsum board assembly is fire rated, sound rated, sound or smoke controlled, or space serves as air plenum.
 - 4. Level 3: At joints and interior angles embed tape in joint compound with 2 separate coats of joint compound applied over joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges.
 - a. Use where heavy grade wall covering is final decoration.
 - b. Use where gypsum board is base for acoustical ceiling tile.
 - 5. Level 4: At joints and interior angles embed tape in joint compound with 3 separate coats of joint compound applied over joints, angles, fastener heads, and accessories. Apply joint compound smooth and free of tool marks and ridges.
 - a. Use for all locations, except those indicated for other finish levels.
 - 6. Level 5: At joints and interior angles embed tape in joint compound with 3 separate coats of joint compound applied over joints, angles, fastener heads, and accessories. Apply thin skim coat, as specified in Joint Treatment Materials Article above, to entire surface. Leave surface smooth and free of tool marks and ridges.
 - a. Use where semi-gloss or gloss finish coatings are final decoration.
 - b. Use for 2 story walls with direct natural day lighting (Lobbies, Entries, Rooms with large day lighting and long walls perpendicular to windows).
 - c. Use at ceilings in Lobbies, assembly areas with direct natural day lighting.
 - d. Use where skim coat finish is indicated.

3.7 FIELD QUALITY CONTROL

- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, verify installation of mechanical, electrical and other facility services work and Installation of ceiling support framing in areas to receive gypsum board ceilings.

END OF SECTION

SECTION 093000 TILING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Quarry tile.
 - 2. Latex-Portland cement mortar and grout.
 - 3. Waterproofing membrane system for tile applications.
 - 4. Sealant and backer materials in tile work.
- B. Related Sections:
 - 1. Section 030000 – Division 03 - Concrete: Concrete subfloors.
 - 2. Section 079000 - Joint Protection: Other sealants.
 - 3. Section 102813 - Toilet Accessories.

1.2 REFERENCES

- A. ANSI A108.5 - Ceramic Tile Installed in Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar.
- B. ANSI A108.10 - Installation of Grout in Tile Work.
- C. ANSI A118.4 - Latex-Portland Cement Mortar.
- D. ANSI A137.1 - Specifications for Ceramic Tile.
- E. Tile Council of North America - Handbook for Ceramic Tile Installation.
- F. MMSA - Materials and Methods Standards Association.

1.3 SUBMITTALS

- A. Shop Drawings: Submit in accordance with Section 013300. Indicate tile patterns and locations; width and locations of control, isolation, contraction and expansion joints in tile surfaces.
- B. Samples: Submit in accordance with Section 013300, for color selection and appearance acceptance.

1.4 QUALITY ASSURANCE

- A. Standards: Comply with applicable reference standards unless otherwise indicated.
- B. Manufacturing Standards: Provide tile to comply with Standard Grade Requirements of ANSI A137.1.
- C. Source of Materials: Provide materials obtained from one source for each type and color of tile, grout, and setting materials.
- D. Installer Qualifications: Engage experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with record of successful in-service performance.

1.5 PRODUCT HANDLING

- A. Deliver, store and handle tile, mortar, and grout materials with care to avoid damage.

1.6 ENVIRONMENTAL CONDITIONS

- A. Provide sufficient heat and ventilation in areas where work of this section is being performed, so as to allow ceramic tile to properly set. Take precautionary measures necessary to ensure that excessive temperature changes do not occur.

1.7 EXTRA MATERIALS

- A. Replacement Materials: Upon completion of work deliver extra tile to Owner for total of one percent of tile used of same size and color for use in future repair and maintenance work.

PART 2 PRODUCTS

2.1 TILE MATERIALS

- A. (QT) Quarry Tile: ANSI A137.1.
 - 1. Slip-resistant units (provide where slip-resistant units are indicated):
 - a. Abrasive-surfaced tile with aluminum oxide abrasive uniformly distributed on face of tile to achieve minimum coefficient of friction of 0.60, ASTM C1028.
 - b. (QTB) Quarry Tile Base.
 - 2. Size: As indicated
 - 3. Types and Colors: As selected by Architect.
- B. Performance:
 - 1. D.C.O.F. Wet: > 0.42
 - 2. Moisture Absorption: < 3.0%
 - 3. Breaking Strength: > 350 lbs.
 - 4. MOH's: 7
 - 5. Chemical Resistance: (non-abrasive) Resistant, (abrasive) N/A
 - 6. Abrasion Resistance: N/A

2.2 CERAMIC TILE ACCESSORIES

- A. Quarry Tile Cleaner: Hillyard's Renovator.

2.3 MORTAR MATERIALS

- A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
 - 1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
 - a. For wall applications, provide nonsagging mortar that complies with Paragraph F-4.6.1 in addition to the other requirements in ANSI A118.4.

2.4 GROUT MATERIALS

- A. Cement Grout materials:
 - 1. Polymer-Modified Tile Grout: ANSI A118.7, color as indicated.
 - a. Polymer Type: Either ethylene vinyl acetate, in dry, redispersible form, prepackaged with other dry ingredients, or acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
- B. Grout Sealer: Provide grout sealer compatible with grout materials as recommended by grout manufacturer.

2.5 WATERPROOFING AND CRACK ISOLATION

- A. Fluid-Applied Waterproofing System: Provide continuous and seamless waterproofing and crack isolation system, including premixed or single-component self-curing liquid-latex rubber or elastomeric-polymer membrane; ANSI A118.10 and ANSI 118.12; ASTM C627 Extra Heavy Service rating; IAPMO-approved as shower pan liner; and recommended by the manufacturer for the application indicated.
 - 1. Pre-treat control joints and cracks in accordance with membrane manufacturer's instructions.
 - 2. Provide reinforcement and accessories as recommended by manufacturer for complete system.

2.6 MISCELLANEOUS MATERIALS

- A. Wall Sealant: Silicone sealant, FS TT-S-001543A, mildew resistant type.
 - 1. Color to match adjacent grout.
- B. Horizontal Joint Sealant: One-part, non-sag, urethane conforming to FS TT-S-00230C, Type II, Class A.
 - 1. Color to match adjacent grout.
- C. Joint Filler or Bond Breaker (under sealant): As specified in Section 079000 - Joint Protection.

2.7 MIXING

- A. Mix and proportion cementitious materials for site made leveling coats, mortar beds and bond coats and grout as recommended by Handbook for Ceramic Tile Installation.
- B. Mix and proportion premix setting bed bond coat and grout materials in accordance with manufacturer's recommendations.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive tile work and conditions under which tile will be installed. Do not proceed with tile work until surfaces and conditions comply with requirements indicated in referenced tile installation standard.
- B. Prior to installing tile work, ensure that surfaces are level, with maximum surface variation of 1/8 inch in 10 feet and sloped to drains.
- C. Prior to installing tile work, coordinate with other trades layout of expansion joints in tile work to ensure expansion joints in substrate and tile work line up.

3.2 PREPARATION

- A. Prepare surfaces to receive tile as recommended by mortar or adhesive manufacturer.
 - 1. Roughen surfaces that are glossy or which have loose surface material by sanding or scarifying.
 - 2. Remove surface material that is not compatible with adhesive.
 - 3. Use primer when recommended by adhesive manufacturer.
 - 4. Clean thoroughly to remove oil, dirt and dust.

3.3 TILE INSTALLATION

- A. Install tile work in accordance with applicable parts of ANSI A108 and manufacturer's printed instructions. Comply with TCNA installation methods as applicable to installation conditions.
 - 1. Achieve 100 percent bond in tile work. Back butter units 8 inch by 8 inch and larger.
- B. Extend tile work into recesses and under equipment and fixtures, to form complete covering without interruptions. Terminate work neatly at obstructions, edges and corners without disruption of pattern or joint alignment.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Grind cut edges of tile abutting trim, finish or built-in items for straight, aligned joints.
 - 1. Fit tile closely to electrical outlets, piping and fixtures so that plates, collars or covers overlap tile.
- D. Expansion Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated, or if not indicated, at spacings and locations recommended in TCNA Handbook for Ceramic Tile Installation, and approved by Architect.
- E. Thoroughly waterproof entire wall behind plumbing fixtures and recessed tile accessories at shower and wet locations such as floor drains, kitchen, cart wash areas, emergency shower areas.

- F. Jointing Pattern: Unless otherwise shown, lay ceramic tile in grid pattern. Align joints when adjoining tiles on floor, base, walls and trim are same size. Layout tile work and center tile fields both directions in each space or on each wall area.
 - 1. Adjust to minimize tile cutting. Provide uniform joint width.
- G. At quarry tile, mix tile prior to installation to provide uniformly dispersed color blending.
 - 1. Provide 3/8 inch wide joints.
 - 2. Unless otherwise indicated, lay quarry tile with end joints centered on tile in adjacent rows in one direction and straight in-line joints in other direction.
- H. Apply grout sealer as recommended by sealer and grout material manufacturers.

3.4 MEMBRANE WATERPROOFING

- A. Preparation: Concrete surfaces to be waterproofed shall be clean and free from loose scale, mortar and structural cracks.
- B. Surface preparation and temperature limitations shall be as recommended by membrane manufacturer. Pre-treat substrate cracks and joints as recommended.
- C. Spray apply membrane waterproofing according to manufacturer instructions, in 2 coat application, with combined dry coat thickness of 0.030 inch (0.8 mm).
- D. Apply two separate layers. Apply first layer to cover base floor substrate below mortar bed continuous from drain and covering entire wall surface to ceiling on each wall. Second layer is applied over the mortar bed and is continuous overlapping into drain and extending 2 feet above water line onto vertical wall surface.
- E. Install at each drain and behind tile at each wet location. Extend waterproofing onto entire wall surface up to ceiling. Include ceiling if recommended by TCA and GA guides.

3.5 EXPANSION JOINTS, SEALANT AND BACKER

- A. Expansion and Control Joints: Locate expansion joints and other sealant filled joints, including control, contraction and isolation joints, where indicated.
 - 1. If not indicated, locate joints at periphery of tile installation, around restraining surfaces, over joints in substrate, and where materials change in substrate, and in field of installation - at minimum 24 feet in each direction, unless otherwise indicated.
 - 2. Spacing of joints shall be in locations recommended in TCNA Handbook for Ceramic Tile Installation EJ171 and as approved by Architect.
- B. Sand or grind tile edges at expansion joints as required to obtain bond. Apply primer to tile edges as recommended by sealant manufacturer.
 - 1. Joint over substrate joint shall not be narrower than joint in substrate.
- C. Sealant Installation: Install sealant as recommended by manufacturer at showers and tubs.
 - 1. Install sealant over backing material at expansion joints in accordance with installation methods and procedures specified in Section 079000 - Joint Protection.
 - 2. Install sealant at joint between tub and tile.
 - 3. Install sealant at corners of tile to tile at bath and shower recesses.

3.6 FIELD QUALITY CONTROL

- A. Upon completion of membrane waterproofing work and prior to tile installation, plug drain or dam areas and fill with water. After 24 hours, inspect for leakage. Make necessary adjustments to stop leakage and re-test until watertight.

3.7 ADJUST AND CLEAN

- A. Clean grout and setting materials from face of tile while materials are workable. Leave tile face clean and free of foreign matter.
- B. Thoroughly soak quarry tile prior to cleaning. Clean with non-acid solution that will not discolor colored grout joints. Immediately scrub with equal parts cleaner and water.

- C. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.
- D. Protect installed tile work with non-staining Kraft paper over 3/4" thick plywood or OSB protection board as called for in the TCNA Handbook for Ceramic Tile Installation to prevent damage and wear during construction period.

END OF SECTION

SECTION 095426 ACOUSTICAL WOOD CEILING AND WALL PLANKS

PART 1 — GENERAL

1.1 SUMMARY:

- A. Section Includes: Acoustical wood plank ceiling and wall system where shown on Drawings, and as specified in this section.

1.2 QUALITY ASSURANCE:

- A. Ceiling and wall system shall maintain the quality as instituted by the Architect or A.W.I.
- B. Design Criteria: Ceiling and wall system shall be installed true and plumb to within manufacturing tolerance of 1/8" within 8' of length.
- C. Product Construction: Wood shall be kiln dried to 10%. Cracking, checking and warpage of members will not be acceptable.

1.3 SUBMITTALS:

- A. Technical Data: Submit manufacturer's data and installation instructions.
- B. Shop Drawings: Submit 4 copies of shop drawings showing all areas involved, attachment conditions and perimeter circumstances.
- C. Submittal Sample: Submit 1 product sample for approval by Architect.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Material must be stored and installed only in secured ambient environment (humidity min. 25% - max. 55%, temperature not to exceed 86 degrees).
- B. Windows, doors and all wet-work must be completed before unpacking and installation. Handle carefully to avoid damage.

PART 2 — PRODUCTS

2.1 PRODUCT TYPE

- A. (LWC) Product: Acoustical wood plank system.
 - 1. Planks have grooves on the face with intersecting holes partially drilled on the backside.
 - 2. Acoustical fabric is factory-mounted on the backside of the planks.
 - 3. Acoustics: NRC of 0.75 with grooves 8mm o.c.
- B. Size: Plank size shall be 7.5" wide x 8', 10', or 12' long x 3/4" thick.
- C. Face Profile: Face grooves shall be 8 mm on center.
- D. Wood Veneer Species: Plain Sliced Book Matched Red Oak.
- E. Finish: Finish shall utilize clear finish with satin sheen. Back of planks shall be factory sealed.
- F. Core: The substrate material shall be manufactured with no added urea formaldehyde.
- G. Fire Rating: Wood panels shall achieve a Class A fire rating.
- H. Edge Condition: T&G edge on long sides, grooves & grain direction running parallel to the long dimension, edge & end banding is NOT available.

- I. Attachment System: Ceiling and wall system shall be mounted according to manufacturers suggested method of suspension. This system shall comply with Seismic Zone 2-4 regulations as required.
- J. Border Trim: Custom border trim as selected by Architect.

PART 3 — EXECUTION

3.1 INSTALLATION

- A. Ceiling and wall system shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by manufacturer.
- B. The contractor shall measure ceiling and/or wall areas to establish layout for hangers and carriers, in accordance with installation instructions.
- C. The ceiling plank suspension system shall be suspended by 15/16" black HD T-grid with main runners on 2' centers and cross T's every 2'. Wall planks shall attach to studs or furring strips.
- D. Contractor shall clean all panels prior to installation according to manufacturer's recommended maintenance procedures. Upon completion of installation, panels shall be inspected and cleaned as needed.

END OF SECTION

SECTION 095446

STRETCH FABRIC WRAPPED CEILING PANELS SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes: Stretch fabric wrapped ceiling panels, consisting of a laterally-suspended textile, applied over a glass-fiber acoustic core and attached to a continuous mounting system.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's product data including certified laboratory test reports and other data required to show compliance with these specifications.
- B. Shop Drawings: Submit shop drawings showing typical reflected ceiling plan, sectional views and details of construction.
- C. Samples: Submit 12 by 12 inch samples of representative fabric with factory detailed edge, and representative samples of devices.
- D. Certified Test Reports: Submit test data from an independent testing agency, acceptable to authorities having jurisdiction, evidencing that systems components comply with requirements indicated for fire performance and recycled content characteristics. Submit test data from independent testing agencies showing that system complies with the specified requirements for acoustical performance.
- E. Extra Stock: Submit an additional 2 percent of each fabric as extra stock for future use.

1.3 QUALITY ASSURANCE

- A. Recycled Content: Fiberglass board core eligible to bear the Green Cross label for recycled content, certified on average to contain at least 40 percent recycled glass, with 10 percent post-consumer and 30 percent pre-consumer content.
- B. Installer Qualifications: Manufacturer's Certified Installer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Project Conditions: Protect system components from excessive moisture in shipment, storage, and handling. Deliver in unopened bundles and store in a dry place with adequate air circulation. Do not deliver material to building until wet conditions such as concrete, plaster, paint, and adhesives have been completed and cured to a condition of equilibrium.

1.5 LIMITED WARRANTY

- A. Limited Warranty: Provide manufacturer's standard limited 2-year warranty against defects in materials and manufacturing. Provide manufacturer's standard limited 10-year warranty against sagging or wrinkles due to heat, humidity or aging.

PART 2 PRODUCTS

2.1 STRETCH FABRIC WRAPPED CEILING PANELS SYSTEM

- A. (SCS) Stretch fabric wrapped ceiling panels system with the following characteristics:
 - 1. Fabric: Ceiling textile color as selected by Architect.

- a. Fabric Type: Fiber content and locking weave not affected by heat or humidity, capable of elongating 25 percent, spot cleanable and dry cleanable. Coated with light polyurethane coating cleanable with water or solvent-based cleaners.
- b. Fabric Size: No seams up to 16 feet; seams allowed over 16 feet.
- c. Fire Performance: NFPA Class A or UBC Class I, ASTM E84 flame spread index 5 or less and smoke developed 15 or less.
- d. Light Reflectance: Minimum light reflectance of 0.85 for white color.
- e. Penetrations: Self supporting at penetrations, cut in fabric without additional reinforcement rings or support.
- 2. Acoustical Core: Standard 1 inch thick medium density glass fiber core.
 - a. Acoustic Performance: ASTM C 423, Type E 400 mounting with minimum NRC of 1.00 at 1-1/2 inch thickness.
- 3. Mounting Devices: Nominal 1/2 inch or 1 inch fire-retardant rigid polymer high-strength extrusions or aluminum extrusions produced in perimeter and mid-seam profiles. Staples, 18 gauge with mechanical ability to attach extrusions, suitable for mounting substrate.
 - a. Fire Performance, Assembly: NFPA Class A or UBC Class I, ASTM E84 flame spread index 5 or less and smoke developed 35 or less.
 - b. Perimeter Track: [Square] [Bevel], with exposed edges selective covered with matching fabric or painted to match the fabric.
 - c. Mid Joint Track: [Square] [Reveal] [Flexible] track as required to achieve design indicated on the Drawings. Capable of installing panels continuously without joints.
 - d. Furring: If core material is thicker than track profile, provide fire retardant treated wood grounds or furrings prior to mounting the track. If edges of grounds are exposed, finish with fabric or painted as selected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions: Examine installation location and conditions under which work is to be performed. Verify wet work is complete and dry. Verify suitable blocking is in place. Notify Contractor in writing of any unsatisfactory conditions. Do not proceed until satisfactory conditions are achieved.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's written instructions and in proper relationship with adjacent construction including the following:
 - 1. Inspect fabric prior to installation. Do not install damaged, imperfect or soiled fabric.
 - 2. Apply mounting system tracks to surfaces to receive system. Secure with 1 inch staples spaced on 2 inch centers.
 - 3. Install mounting system tracks level and straight, flush and in proper alignment.
 - 4. Install acoustical core material continuous and flush to the edge of the track in largest sizes practical and secure in place with appropriate adhesives or staples. For fabric closer than 1/4 inch to the core, caulk joints or provide a white scrim or lining to prevent read through. Scrim or lining shall not inhibit the acoustical performance of the system, and meet fire safety code requirements.
 - 5. Stretch shop cut fabric and secure into the locking jaws to produce a smooth surface, free of wrinkles or puckers. Adjust fabric to meet the required dimensional layout.

3.3 CLEANING AND PROTECTION

- A. Clean exposed surfaces as necessary. Comply with manufacturer's instructions for cleaning and repair of minor finish damage. Remove and replace work that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

- B. Advise Contractor of required protection, including soiling from other trades and dust control, so that the work will be without damage and deterioration at the time of acceptance.

END OF SECTION

SECTION 096500 RESILIENT FLOORING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Vinyl tile flooring.
 - 2. Resilient sheet flooring.
 - 3. Linoleum sheet flooring.
 - 4. Resilient flooring accessories.
 - 5. Cleaning and waxing of resilient flooring.
- B. Related Sections:
 - 1. Section 030000 - Concrete: Finish floor slab and moisture treatment.

1.2 SUBMITTALS

- A. Shop Drawings: Submit layout drawings on sheet flooring showing seam locations, pattern direction, and type of edge treatment used in accordance with Section 013300.
- B. Slab Moisture Content and Calcium Chloride Test Results: Submit to Architect.
- C. Samples: Submit samples of tile and sheet flooring in accordance with Section 013300.
- D. Maintenance Instructions: Submit manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring.

1.3 QUALITY ASSURANCE

- A. Provide each type of resilient flooring produced by single manufacturer, single run.
- B. Applicator Qualifications: Installation of resilient flooring shall be by manufacturer's approved applicator.
- C. Job Mock-Up: Make sample installation of vinyl base on project surfaces as directed by Architect. Obtain acceptance of sample field installation and accomplish work to equal or exceed standard established by accepted sample.

1.4 PRODUCT HANDLING

- A. Deliver resilient flooring materials in manufacturer's protective packaging. Store and handle flooring with care to prevent damage.

1.5 PROJECT CONDITIONS

- A. Maintain temperature in areas of installation as recommended by resilient flooring manufacturer.

1.6 EXTRA MATERIAL

- A. Replacement Materials: Deliver not less than one percent of total project quantity of each type, size and color of material to Owner for replacement materials.
- B. Clearly identify each container as replacement materials.

PART 2 PRODUCTS

2.1 FLOOR COVERING MATERIALS

- A. Slip Resistance of Flooring Materials: Provide materials with 0.6 coefficient of friction or greater when tested in accordance with ASTM 2047.
- B. Resilient Vinyl Flooring: ASTM F1913, Type as indicated by product selected.

1. (RSF-1)Type, color and pattern:
 - a. Luxury vinyl floor covering with reinforced surface in tile and plank form.
 - b. Constructed with heterogeneous calendared layers reinforced with non-woven glass fiber combined with a polymeric base with a PVC wear layer and a vinyl balancing layered backing.
 - c. Performance:
 - 1) Sheet material meets ASTM F 1700 – Class III – Type B performance standards for luxury vinyl floor tile.
 - 2) Static coefficient of friction (ASTM D 2047): 0.6 or greater.
 - 3) Static Load Limit (ASTM F 970): 250 PSI – Passes.
 - 4) Resistance to Heat (ASTM F1514): $\Delta\Sigma \leq 8.0$
 - 5) Resistance to Light (ASTM F 1515): $\Delta\Sigma \leq 8.0$
 - 6) Electrostatic Propensity (EN1815): < 2 kv
 - 7) Fire Performance, Critical Radiant Flux (ASTM E 648): Greater than 0.45 W/cm² - Class 1
 - 8) Chemical Resistance (ASTM F 925): Passes.
- C. Resilient Linoleum Sheet Flooring: ASTM F2034.
 1. (RSF-2) Type, color and pattern:
 - a. Homogeneous floor covering made from natural ingredients including linseed oil, rosin binders, wood flour, limestone and dry pigments which are mixed and then calendared onto a natural jute backing. Top coat is a double UV cured double layer technology.
 - b. Physical Characteristics:
 - 1) Gauge: 1/10"
 - 2) Backing: Jute.
 - 3) Width: 79"
 - 4) Length: 105'
 - c. Meets or exceeds all technical requirements as set forth in ASTM F 2034 Standard Specification for Linoleum Sheet Flooring, Type I.
- D. Resilient Sheet Flooring: ASTM F1913, Type as indicated by product selected.
 1. (RSF-3)Type, color and pattern:
 - a. Homogeneous flooring is composed of a 0.080" reinforced wear layer containing 50% or more binder content that is urethane reinforced to eliminate the need for polish or waxes throughout the life cycle of the product.
 - b. Performance:
 - 1) Sheet material meets ASTM F 1913 performance standards for homogeneous single layered vinyl floor covering.
 - 2) Static coefficient of friction (ASTM D 2047): 0.6 or greater.
 - 3) Static Load Limit (ASTM F 970): 250 PSI – Passes.
 - 4) Fire Performance:
 - (a) Flooring Radiant Panel: ASTM E 648 – Class 1
 - (b) Smoke Density: ASTM E 662 Less than 450.
- E. Rubber Tile Flooring: ASTM F1344, Type as indicated by product selected.
 1. (RSF-4) Type, color and pattern:
 - a. ASTM Specification: ASTM F1344 Standard Specification for Rubber Floor Tile, defined as Type IB and Grade 2
 - b. Limited Wear Warranty: 10 years
 - c. Material: vulcanized rubber compound with environmentally compatible color pigments that are free of toxic heavy metals like lead, cadmium or mercury.
 - d. Composition: Homogeneous rubber compound with a random scattered design.
 - e. Surface: Hammered.
 - f. Back of Tile/Sheet/Nosing: Double-sanded smooth.
 - g. Material Size: ~39.53 inches by ~39.53 inches, ASTM F2055 ± 0.02 is required.
 - h. Squareness: ASTM F2055, ± 0.010 inches is required.
 - i. Thickness: ~0.14 inches, ASTM F386, + 0.015/-0.005 inches is required.
 - j. Depth: Not applicable.
 - k. Dimensional Stability: ASTM F2199, $\leq 0.15\%$ in both directions is required.

- l. Flammability: ASTM E648; NFPA 253; NBSIR 75 950, 1.0 achieved, ≥ 0.45 watts/sq. cm for Class 1 is required.
 - m. Smoke Density: ASTM E662; NFPA 258; NBS, 334 (flaming) and 168 (non-flaming) achieved, < 450 is required.
 - n. Tunnel Test: Not applicable.
 - o. CAN/ULC-S102.2: Surface Burning, FSC1 of 70 and SD of 470, achieved.
 - p. Burn Resistance: Resistant to cigarette and solder burns.
 - q. Slip Resistance: ASTM D2047 Static coefficient of friction, Neolite dry 0.99, Neolite wet 0.95 achieved, ≥ 0.5 is required.
 - r. Bacteria Resistance: ASTM E2180 and ASTM G21, resistant to bacteria, fungi, and micro-organism activity.
 - s. VOC's: This flooring is GREENGUARD Gold Certified for Low VOC Emissions, GREENGUARD Certified for Low VOC Emissions, Blue Angel Certified and CA 01350 Compliant.
 - t. Latex Allergies: ASTM D6499, Inhibition Elisa, results are below detection level.
 - u. Sound Absorption: ASTM E2179 Δ IIC 11, ISO 140 Δ L_w 11 dB (compare only Δ values).
 - v. Sound Generation: Not applicable
 - w. Hardness: ASTM D2240, Shore type "A", 82 achieved, ≥ 70 is required.
 - x. Static Load: ASTM F970, Residual compression of 0.005" with 800 lbs. achieved, ≤ 0.005 " with 250 lbs. is required.
 - y. Rolling Load Limit: ≤ 850 lbs. / sq. inch
 - z. Abrasion Resistance: ASTM D3389, 1.1 lbs. load on H-18 wheel with 1000 cycles, 0.002 oz. weight loss achieved, ≤ 0.035 oz is required.
 - aa. Elongation: Not applicable
 - bb. Oil & Grease Resistance: Yes
 - cc. Heat Resistance: Not applicable
 - dd. Light Resistance: ASTM F1515, Avg. $\Delta E \leq 8.0$, easily achieved with all batches and regular maintenance
 - ee. Static Generation: AATCC 134, < 2000 Volts at 20% RH, achieved
 - ff. Decay Time: Not applicable
 - gg. Conductivity: Not applicable
 - hh. Thermal Transmission: Not applicable
- F. Colors and Patterns: Provide tile units with uniformly distributed color and pattern throughout thickness of tile.
- G. Sheet Cove Cap or Zero Edge Reducing Strip and Fillet Strip: Plastic cap or reducing strip and fillet strip as recommended by manufacturer for integral or flash cove base. Security sealants, tamper proof and pick proof.

2.2 FILLERS/ADHESIVES/SEALERS

- A. Sub-Floor Filler: White premix latex, mix with water to produce cementitious paste.
- B. Primers and Adhesives: Water-resistant stabilized type as recommended by resilient flooring manufacturer for specific material.
- C. Flooring Adhesives: Adhesive recommended and approved by flooring manufacturer, zero VOC, tested by the adhesive manufacturer for use with the specified flooring product; Submit approval documentation by both flooring manufacturer and adhesive manufacturer as compatible with substrate, flooring, project conditions, use, expected traffic, equipment loads and surface conditions including alkalinity, moisture emission levels, slab relative humidity, and other factors that may affect flooring and adhesive performance.
- D. Adhesive and Sealant VOC Limits: According to South Coast Air Quality Management District Rule 1168 and GS-36 for aerosols. VOC Limits: As tested using U.S. EPA Reference Test Method 24 and as defined by South Coast Air Quality Management District Rules: SCAQMD Rule 1168, Adhesive and Sealant Applications
- E. Polish: Type recommended by resilient flooring material manufacturer for material type and location.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which resilient flooring is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 SITE AND SUBSTRATE CONDITIONS

- A. Ensure floor surfaces are smooth and flat with maximum variation of 1/8 inch in 10 feet.
- B. Ensure concrete floors are dry and meet moisture conditions required by flooring and adhesive manufacturer's and exhibit negative alkalinity, carbonization or dusting. Also ensure substrate meets requirements of adhesive and flooring manufacturer's requirements. Remove curing agents and other surface residue that may negatively affect adhesion or flooring installation and performance.
- C. Floor Substrate Criteria:
 - 1. Moisture vapor emissions do not exceed 75 percent RH when tested in accordance with ASTM F2170 unless otherwise required by finished flooring and adhesive manufacturer.
 - 2. Moisture in concrete slab conditions up to 3lb. per 1,000 sq. ft. per 24 hours when tested with a prepackaged calcium chloride crystal kit performed in accordance with ASTM F1869 unless otherwise required by finished flooring and adhesive manufacturer.
 - 3. Concrete slab alkalinity conditions up to a pH of 6-9 when tested in accordance with ASTM F710 with in-situ monitoring, unless otherwise required by finished flooring and adhesive manufacturer.
 - 4. Maintain testing records and submit along with warranties for Project Record Documents.
- D. Maintain minimum 70 degrees F air temperature at flooring installation area for 3 days prior to, during, and for 24 hours after installation.
- E. Store flooring materials in area of application. Allow 3 days for material to reach equal temperature as area.

3.3 LEVELING

- A. Preparation: Prepare substrate surfaces to receive resilient flooring as recommended by adhesive manufacturer and resilient flooring manufacturer.
 - 1. Remove subfloor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with subfloor filler.
 - 2. Clean floor and apply, trowel and float filler to leave smooth, flat hard surface. Prohibit traffic until filler is cured.

3.4 INSTALLATION - FLOORING

- A. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged. Lay tile with grain in tile running in same direction, unless otherwise shown.
- B. Clean substrate. Spread adhesive evenly in quantity recommended by manufacturer to ensure adhesion over entire area of installation. Spread only enough adhesive to permit installation of flooring before initial set.
- C. Set flooring in place; press with heavy roller to ensure full adhesion. Tightly adhere flooring to substrate without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, or other surface imperfections.
- D. Lay flooring with joints and seams parallel to building lines to produce minimum number of seams and symmetrical tile pattern as indicated.
- E. Lay tile from center marks established with principal walls, discounting minor offsets, so tile at opposite edges of room are of equal width. Install with minimum tile width 1/2 full size at room or area perimeter, to square grid pattern with joints aligned unless otherwise indicated.

- F. Install sheet flooring to minimum of 1/3 full material width and with sheet parallel to length of room unless otherwise indicated. Lay sheet flooring to provide as few seams as possible. Double cut sheet and continuously heat seal or heat weld seams in vinyl sheet flooring to provide seamless installation. Match seam edges for color shading and pattern.
- G. Terminate resilient flooring at centerline of door openings where adjacent floor finish is dissimilar.
- H. Scribe flooring to walls, columns, cabinets, floor outlets and other appurtenances to produce tight joints. Cut flooring neatly to and around fixtures.
- I. Install flooring wall to wall. Install under mobile or modular cabinets, and other items to produce wall to wall floor in all rooms.
- J. Butt flooring tightly to vertical surfaces, thresholds, nosings and edgings. Scribe around obstructions and to produce joints, laid tight, even, and straight. Extend flooring into toe spaces, door reveals, and into closets and similar openings.
- K. Install flooring on covers for telephone and electrical ducts, in pan type floor access covers, and other such items as occur within finished floor areas. Maintain overall continuity of color and pattern with pieces installed in these covers.
- L. Continue flooring through areas to receive moveable type partitions without interrupting floor pattern.
- M. Install feature strips and floor markings where indicated. Fit joints tightly.

3.5 INSTALLATION - ACCESSORIES

- A. Apply wall base to walls, columns, pilasters, cabinetwork and other permanent fixtures in rooms or areas where base is required. Coped inside corners; install preformed outside corners. Tightly bond base to backing and fit joints tight and vertical.
- B. Install base on solid backing. Adhere tightly to wall and floor surfaces throughout length of each piece, with continuous contact at horizontal and vertical surfaces. Scribe and fit to door frames and other obstructions.
- C. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edge strips at unprotected edges of flooring and at door jambs between rooms with different color or pattern of flooring.
- D. Adhere accessories over each entire surface and fit accurately and securely.

3.6 PROTECTION

- A. Prohibit traffic from floor finish for 48 hours after installation. Protect flooring from damage by use of protective covering.

3.7 CLEAN-UP

- A. Remove excess adhesive or other surface blemishes from floor, base and wall surfaces without damage, and as recommended by flooring manufacturer.

3.8 FINISHING

- A. After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories. Apply sealer, wax and buff, with type of sealer, wax, number of coats and buffing procedures as recommended by flooring manufacturer for new flooring installation. Seal and wax floor and base surfaces in accordance with manufacturer's recommendations.

END OF SECTION

SECTION 097200 WALL COVERINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Fabric wall covering (FWC).
- B. Related Sections:
 - 1. Section 092900 - Gypsum Board: Substrate prep.
 - 2. Section 099000 - Painting: Substrate prep and priming of surfaces to receive wall covering.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include data on physical characteristics, durability, fade resistance, and flame-resistance characteristics.
- B. Shop Drawings: Show location and extent of each wall-covering type.
 - 1. Indicate pattern placement, seams and termination points.
- A. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inches long.
 - 1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.
- B. Product Schedule: For wall coverings. Use same designations indicated on Drawings.
- C. Qualification Data: For qualified testing agency.
- D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.
- E. Maintenance Data: For wall coverings to include in maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm with not less than 5 years experiences in installation of systems similar in complexity to those required for this Project, including specific requirements indicated.
 - 1. Acceptable to or licensed by manufacturer.
 - 2. Successfully completed not less than 5 comparable scale projects using this system.
- B. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
 - 1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
 - 2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Packing and Shipping: Deliver products in original unopened packaging with legible manufacturer's identification.
- B. Storage and Protection: Comply with manufacturer's recommendations.
 - 1. Store in a cool, dry place out of direct sunlight.
 - 2. Protect from damage by the elements and construction procedures.
 - 3. Store at temperature above 40 degrees F.

1.5 PROJECT CONDITIONS

- A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
- B. Lighting: Do not install wall covering until a permanent level of lighting is provided on the surfaces to receive wall covering.
- C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

1.6 EXTRA MATERIALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Wall-Covering Materials: For each type, full-size units equal to 5 percent of amount installed.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 450 or less.
 - 2. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 265 and complying with Method A test protocol in IBC 2000, Section 803.5.1.

2.2 FABRIC WALL COVERING

- A. (FWC) Fabric Wall-Covering: Provide mildew-resistant textile wall coverings in rolls from the same production run, and in compliance with the following:
 - 1. ASTM F 793 Category VI, Type III, Commercial Serviceability.
 - 2. Test Responses:
 - a. Colorfastness to Wet and Dry Crocking: Passes AATCC 8, Grade 3, minimum.
 - b. Colorfastness to Light: Passes AATCC 16, Option 1 or 3, Grade 4, minimum, at 40 hours.
 - 3. Composition:
 - a. Contents: 60% Biobased PE, 40% PE.
 - b. Applied Backing Material: Acrylic.
 - c. Width: 52"
 - d. Seaming and Stitching of Fabric Wall Covering: Comply with wall covering manufacturer's recommendations.
 - 4. Colors, Textures, and Patterns: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, non-staining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099000 - Painting and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.
- C. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Schedule installation of wall covering at appropriate time during progress of work to prevent damage during construction and movement of materials.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions for surface preparation.
- B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- C. Fill seams, joints, nicks, gouges and other minor imperfections of substrate wall surfaces with latex block filler. Sand smooth flush with surface.
 - 1. Follow with prime coat of sealer recommended by wall covering manufacturer.
- D. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Gypsum Board Substrate:
 - a. Tape and sand gypsum board assemblies in accordance with Section 092900 – Gypsum Board to achieve smooth and flat substrate for cork wall covering.
 - b. Prime gypsum board surfaces receiving wall covering as recommended by manufacturer.
 - 4. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- E. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.
- F. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- G. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL-COVERING INSTALLATION

- A. General: Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated except where more stringent requirements apply.
- B. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- C. Install strips in same order as cut from roll.
 - 1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
- D. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- E. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- F. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.
- G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.

3.4 CLEANING

- A. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- B. Use cleaning methods recommended in writing by wall-covering manufacturer.
- C. Replace strips that cannot be cleaned.
- D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION

SECTION 098433 FABRIC WRAPPED ACOUSTICAL WALL PANELS

PART 1 – GENERAL

1.1 SUMMARY

- A. Section Includes: Fabric Wrapped Acoustical Wall Panels
- B. Related Section/Items
 - 1. Section 092900 - Gypsum Board.
 - 2. Section 097200 – Wallcoverings.

1.2 SUBMITTALS

- A. Product Data:
 - 1. Manufacture Specifications and other data needed that provides proof of compliance with specified requirements.
 - 2. Include technical information, maintenance instructions and the following test data: Class 1 or A flame spread rating per ASTM E-84, NRC rating in accordance with ASTM C-423.
- B. Shop Drawing:
 - 1. Provide complete shop drawings showing all wall layouts, to include panel joints, detailed references, dimensions and the method of attachment.
- C. Samples:
 - 1. Submit 2 each 12 X 12 inch samples of actual acoustical / tackable panel core showing edge detail illustrating specified fabric covering, to include mounting device.
 - 2. Submit full range of manufacturer's color selection of fabric specified.
 - 3. Submit manufacturer's installation instructions under provisions of Section 013300.
 - 4. Submit test reports verifying flame/smoke ratings Class 1/A ASTM E-84.

1.3 QUALITY ASSURANCE

- A. Single Source Responsibility: Obtain acoustical panel materials from a single manufacture with 10 years documented experience. Provide acoustical panels and fabrics of each type required from one (1) manufacturer, of uniform texture and color.
- B. Installer/Applicator: Company specializing in installing acoustical/tackable panel systems with 10 years documented experience and that installation method proposed is acceptable to panel manufacturer.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Protect all products during shipment, storage and installation.
- B. Deliver fabricated units and components to job site in unopened packages or crates, store elevated above floor in an enclosed space with proper ventilation and protection from damage.
- C. On-site storage to be secured within a storage area that is climatically controlled to normal operational levels.

1.5 EXTRA MATERIAL

- A. Provide 30 feet of each fabric pattern and color for future repair use.
- B. Package and label each roll by manufacturer, color, pattern and designated room number; store where directed.

1.6 WARRANTY

- A. Products to carry a 2 year limited warranty against workmanship or product defects.

PART 2 – PRODUCTS

2.1 MATERIALS

- A. (AWT) Fabric Wrapped Acoustical Wall Panels.
- B. Flame Spread: Acoustical Panels to have a Class 1 flame spread rating per ASTM E-84.
- C. Acoustical/Tackable Panels shall be constructed of a 100% Polyester core (60% PET-Recycled Fiber, 40% PET-Virgin Fiber).
- D. Panel thickness: 1 inch.
- E. Sizes: Shall be as noted on Drawings not to exceed 4' x 10' in overall width & height and to coordinate with any fabric repeat that exists. Panels are to be manufactured according to field verified dimensions supplied by the installing contractor. Standard tolerances are to be +/- 1/16" in width and height.
- F. Edge Profile: Shall be either a square or beveled chemically treated hardened edge profile.
- G. Acoustical Performance: Panels shall maintain a minimum NRC rating of .75 in accordance with ASTM C-423.
- H. Fabric Finish: Fabric shall be applied directly to face and all edges of the panel, returning onto the back side of the panel providing a full finish detail. Corners are to be fully tailored.
 - 1. Fabric: as selected by Architect.
- I. Fabric Direction: Shall be applied to face of panel vertically, aligning repeats on panel joints achieving a uniform and continuous match pattern.
- J. Mounting of Panels: Z clip attachments.

PART 3 – EXECUTION

3.1 INSPECTION

- A. Verify all dimensions to ensure proper fabrication of materials.
- B. Contractor shall be responsible for the final examination of all surfaces & edges to accept conditions prior to the panel installation.

3.2 INSTALLATION

- A. Installation of acoustical panels shall not begin until all wet work (concrete, gypsum board finishing, painting, etc.) is completed and completely dry. Building shall be properly sealed and under standard occupancy conditions (temperature shall be 60-85° F and not more than 60% relative humidity) before installation begins.
- B. Install panels and fabrics in accordance with manufacturer's instructions / approved shop drawings.
- C. Mounting of Panels: Construction grade adhesive & finish nails.
- D. Arrange panels symmetrically on each wall, unless otherwise indicated.
- E. Arrange acoustical panels in orientate directional pattern, if any.
- F. Remove panels that are damaged and unacceptable to Architect, replace with acceptable finished panels at no expense to owner.
- G. Installation cannot commence until unacceptable conditions are corrected.

END OF SECTION

SECTION 099000 PAINTING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Painting and finishing of new materials.
 - 2. Preparation of surfaces for painting and finishing.
 - 3. Repainting and refinishing of existing surfaces.
 - a. Preparation of existing surfaces for repainting and refinishing.
 - 4. Smoke and fire partitions stenciling, and pipe painting.
- B. Related Sections:
 - 1. Section 092900 - Gypsum Board: Spray texture ceiling finish.
 - 2. Section 097200 - Wall Coverings: Primer/sealer on surfaces to receive wall covering.
 - 3. Section 099600 - High Performance Coatings.

1.2 SUBMITTALS

- A. Product Data: For each paint system specified. Include block fillers and primers.
 - 1. Material List: Provide inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use.
 - 3. Certification by manufacturer that products supplied comply with local regulations controlling use of volatile organic compounds (VOCs).
- B. Samples: Submit paint and transparent finish samples in accordance with Section 013300, for color selection and finish acceptance.
 - 1. Paint Colors, Surface Treatments and Finishes: As selected by Architect. Submit three 8 inch by 10 inch samples to be reviewed for color and sheen. Architect reserves right to select color or finish from any manufacturer, herein specified, as necessary to achieve desired color or finish.
- C. Schedule: For acceptance, submit 3 copies of complete schedule showing each product by number and brand name proposed to be used at each surface and location. Generally follow specified outline and list number of coats.

1.3 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat paint produced by same manufacturer as finish coats.
- B. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- C. Applicator Qualifications: Engage experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with record of successful in-service performance.
- D. Mock-up
 - 1. Job Site Sample Areas: Make sample application of high performance epoxy coating on project surfaces to the extent of one system on one wall of one room as directed by Architect.
 - a. Obtain acceptance of sample field application before making additional applications.
 - b. Accomplish work to equal or exceed standards established by approved samples. Protect and maintain approved field samples through completion of project.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver paint materials in sealed original labeled containers, bearing manufacturer's name, type of paint, brand name, color designation and instructions for mixing or reducing.
- B. Provide adequate storage facilities. Store paint materials at minimum ambient temperature of 45 degrees F in well ventilated area. Restrict storage to paint materials and related equipment.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion. Comply with health and fire regulations.

1.5 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with manufacturer's recommendations as to environmental conditions under which painting and finishing can be applied. Do not apply finish in areas where dust is being generated.
- B. Measure moisture content of surfaces using electronic moisture meter. Do not apply finishes unless moisture contents of surfaces are below following maximums:
 - 1. Gypsum Wallboard: 12 percent.
 - 2. Concrete and Concrete Block: 12 percent.
 - 3. Interior Wood: 15 percent.
- C. Ensure surface temperature and surrounding air temperature is above 40 degrees F before applying finishes. Minimum application temperature for latex paints for interior work shall be 45 degrees F and 50 degrees F for exterior work. Minimum application temperature for transparent finish shall be 65 degrees F, or surface and air temperature shall be 5 degrees above dew point.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 45 degrees F for 24 hours before, during and 48 hours after application of finishes.
- E. Provide minimum 25 foot candles of lighting on surfaces to be finished.

1.6 EXTRA MATERIALS

- A. Furnish extra paint materials from the same production run as the materials applied and in the quantities described below. Package with protective covering for storage and identify with labels describing contents. Deliver extra materials to Owner.
 - 1. Quantity: Furnish Owner with extra paint materials in quantities indicated below:
 - a. Interior, Paint: 1 gal. of each color applied.
 - b. Exterior, Paint: 1 gal. of each color applied.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.
 - a. Refer to Painting and Finishing Schedule at end of this Section.
 - 1) Colors (PT): Paint Systems indicated in Schedule in Part 3
 - (a) Colors: to be selected by Architect.
 - 2) Colors (PTE): Epoxy Paint Systems indicated in Schedule in Part 3
 - (a) Colors: to be selected by Architect.

- C. Sheen: When one of following terms is used to denote specific sheen for coating listed, following index shall apply:
 - 1. Flat: Less than 15 units based on 85 degrees of sheen.
 - 2. Eggshell: 5 to 20 units based on 60 degrees of sheen.
 - 3. Satin/Low Lustre: 15 to 35 units based on 60 degrees of sheen.
 - 4. Semi-gloss: 30 to 65 units based on 60 degrees of sheen.
 - 5. Gloss: Above 65 units based on 60 degrees of sheen.
- D. Paint Colors: to be selected by Architect.

2.2 MIXING AND TINTING

- A. Deliver paints ready-mixed to job site.
- B. Job mixing and job tinting is not acceptable.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive paint and transparent finishes for conditions that would adversely affect execution, permanence or quality of work and which cannot be put into acceptable condition through preparatory work. Do not proceed with surface preparation or coating application until conditions are suitable.

3.2 PREPARATION OF SURFACES

- A. Perform preparation and cleaning procedures in accordance with paint manufacturer's instructions and as specified, for each particular substrate condition.
 - 1. Remove mildew, by scrubbing with solution of detergent, bleach and warm water. Rinse with clean water and allow surface to dry completely.
 - 2. Remove surface contamination from aluminum surfaces requiring paint finish by steam, high pressure water or solvent washing. Apply etching primer or acid etch. Apply paint immediately if acid etching.
 - 3. Remove contamination from copper surfaces requiring paint finish by steam, high pressure water or solvent washing. Apply vinyl etch primer or acid etch. Apply paint immediately if acid etching.
 - 4. Provide barrier coats over incompatible primers or remove and reprime as required. Notify Architect in writing of anticipated problems in using specified coating systems with substrate primed by others.
- B. Remove hardware, hardware accessories, plates, lighting fixtures, and similar items in-place and not to be finish painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary, for complete painting of items and adjacent surfaces. Following completion of painting of each space or area, reinstall removed items by workmen skilled in trades involved.
- C. Clean surfaces to be painted before applying paint or surface treatment. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning. Program cleaning and painting so that dust and other contaminants from cleaning process will not fall in wet, newly painted surfaces.
 - 1. Remove dirt, oil, grease and sand if necessary to provide adhesion key, when asphalt, creosote or bituminous surfaces require paint finish. Apply compatible sealer or primer.
 - 2. Remove dirt, grease and oil from canvas and cotton insulated coverings.
- D. Cementitious Materials: Prepare cementitious surfaces of concrete, concrete block and cement plaster to be painted by removing efflorescence, chalk, dust, dirt, grease, oils, and by roughening as required to remove glaze. Determine alkalinity and moisture content of surfaces to be painted by performing appropriate tests. If surfaces are found to be sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application of paint.

1. Remove contamination, acid etch and rinse new concrete floors with clear water. Ensure required acid alkali balance is achieved. Allow to thoroughly dry. Repeat procedure if necessary to achieve a medium sandpaper-like profile.
 2. Remove dirt, loose mortar, scale, powder and other foreign matter from concrete and concrete block surfaces which are to be painted or to receive clear seal. Remove oil and grease with solution of trisodium phosphate, rinse well and allow to thoroughly dry.
 3. Remove stains from concrete and concrete block surfaces caused by weathering of corroding metals with solution of sodium metasilicate after being thoroughly wetted with water. Allow to thoroughly dry.
- E. Gypsum Wallboard: Remove contamination from gypsum wallboard surfaces and prime to show defects, if any. Paint after defects have been remedied.
- F. Plaster Surfaces: Fill hairline cracks, small holes and imperfections on plaster surfaces with patching plaster. Smooth off to match adjacent surfaces. Wash and neutralize high alkali surfaces where they occur.
- G. Galvanized Surfaces: Clean free of oil and surface contaminants with acceptable non-petroleum based solvent.
- H. Ferrous Metals: Clean non-galvanized, ferrous surfaces that have not been shop-coated of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning, complying with Steel Structures Painting Council (SSPC)-SP3.
1. Touch-up shop-applied prime coats which have damaged or bare areas. Wire-brush, solvent-clean, and touch-up with same primer as shop coat.
 2. Clean unprimed steel surfaces by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned. Prime surfaces to indicate defects, if any. Paint after defects have been remedied.
 3. Sand and scrape shop primed steel surfaces to remove loose primer and rust. Feather out edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. (Prime steel including shop primed steels.)
- I. Wood: Clean wood surfaces to be painted of dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view, and dust off.
1. Prime or seal wood required to be job painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood.
 2. When transparent finish is required, back-prime with one coat of same material as used for surface.
 3. Seal tops, bottoms and cut-outs of wood doors with coat of surface finish immediately upon delivery to job for field painted doors only.
 4. Scrape and clean small, dry, seasoned knots and apply thin coat of white shellac or other recommended knot sealer, before application of priming coat.
 5. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood-filler. Sandpaper smooth when dried.
 6. Remove dust, grit and foreign matter from exterior wood siding which is to receive paint finish. Seal knots, pitch streak and sappy sections. Fill nail holes with exterior caulking compound after prime coat has been applied.
 7. Prior to finishing glue laminated beams, wash down surfaces with solvent and remove grease and dirt.
- J. Existing Surfaces to be Repainted or Refinished: Wash surfaces to remove grease, oil, soil or other matter which will interfere with proper bond of new materials. Scrape and wire brush loose or flaking paint. Fill cracks, voids or other defects.

3.3 MATERIALS PREPARATION

- A. Mix and prepare painting materials and transparent finish materials in accordance with manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing, and application of paint in clean condition, free of foreign materials and residue.

- C. Stir materials before application to produce mixture of uniform density, and as required during application of materials. Do not stir any film that may form on surface into material. Remove film and, if necessary, strain material before using.

3.4 APPLICATION

- A. Do not apply to wet or damp surfaces.
 - 1. Wait at least 30 days before applying to new concrete.
 - a. Test concrete for moisture content to verify manufacturer's surface moisture requirements are met.
 - b. Follow manufacturer's procedures to apply appropriate coatings prior to 30 days.
 - 2. Wait until wood is fully dry after rain, fog or dew.
 - a. Test wood for moisture content to verify manufacturer's surface moisture requirements are met.
- B. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
 - 1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 - 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 - 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.
 - 4. Apply each coat at proper consistency.
 - a. Uniformly apply coatings without runs, drips, or sags, without brush marks, and with consistent sheen.
 - 5. Each coat of paint shall be slightly darker than preceding coat unless otherwise approved by Architect.
 - 6. Provide finish coats which are compatible with prime paints used.
- C. Do not apply succeeding coats until previous coat has completely dried. Sand between each enamel or varnish coat application with fine sandpaper, or rub surfaces with pumice stone where required to produce even, smooth surface in accordance with coating manufacturer's directions.
 - 1. Allow each coat of finish to dry before following coat is applied, unless directed otherwise by manufacturer.
- D. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint, until paint film is of uniform finish, color and appearance. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive film thickness equivalent to that of flat surfaces.
- E. Finish doors on tops, bottoms, and side edges same as exterior faces, unless otherwise indicated.
- F. Film Thickness: Apply materials in accordance to paint manufacturer's recommendations and spreading rates to provide total dry film thickness as recommended.
 - 1. Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated
 - 2. Use precision instruments designed for measuring and evaluation wet and dry films of paints and coatings.
 - 3. Results measuring less than recommended thickness will require additional material application.
 - a. Regardless of number of coats specified, apply as many coats as necessary for complete hide, and uniform appearance.
 - 4. Use of poor hiding colors may require application of additional coats in order to achieve proper coverage and hiding.
- G. Apply first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
- H. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat of paint does not cause lifting or loss of adhesion of undercoat.

- I. Prime Coats: Recoat primed and sealed walls and ceilings where there is evidence of suction spots or unsealed areas in first coat, to assure finish coat with no burn-through or other defects due to insufficient sealing.
- J. Stipple Enamel Finish: Roll and redistribute paint to even and fine texture. Leave no evidence of rolling such as laps, irregularities in texture, skid marks, or other surface imperfections.
- K. Transparent Finish: On exposed portions, use multiple coats to produce glass-smooth surface film continuity of even luster. Provide finish free of laps, cloudiness, color irregularity, runs, brush marks, orange peel, nail holes, or other surface imperfections. Provide satin finish for final coats, unless otherwise indicated.
- L. Repainting of Existing Surfaces: Where repainting of existing surfaces is required, repaint wall and ceiling surfaces in their entirety, patch or spot painting is not acceptable.
- M. Paint surfaces behind movable equipment or furniture same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only.
- N. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.5 MECHANICAL AND ELECTRICAL EQUIPMENT

- A. Refer to mechanical and electrical documents with respect to field painting and finishing requirements. Painting of mechanical and electrical work is not required in pipe chases, tunnels, and mechanical rooms with unpainted walls.
- B. Remove grilles, covers and access panels for mechanical and electrical systems from location and paint separately.
- C. Finish paint primed equipment to color selected.
- D. Prime and paint insulated and bare pipes, conduits, boxes, insulated and bare ducts, hangers, brackets, collars and supports, except where items are plated or covered with prefinished coating, or where they are not in finished space or room.
- E. Paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvers before installation of equipment with 1 coat of flat black paint, to limit of sight line. Paint dampers exposed immediately behind louvers, grilles, convector and baseboard cabinets to match face panels.
- F. Paint exposed piping, insulated piping and conduit occurring in finished areas. Color and texture to match adjacent surfaces.
- G. Paint both sides and edges of plywood backboards for electrical equipment before installing backboards and mounting equipment on them.

3.6 CLEANING

- A. As work proceeds and upon completion, promptly remove paint where spilled, splashed or spattered. Touch up and restore damaged or defaced painted areas.
- B. During progress of work keep premises free from unnecessary accumulation of tools, equipment, surplus materials and debris. Remove at end of each workday.
- C. Upon completion of work clean window glass and other paint-spattered surfaces and leave premises neat and clean, to satisfaction of Architect.

3.7 PROTECTION

- A. Adequately cover or otherwise protect finished work of other trades and other surfaces from paint and damage. Repair damage as result of inadequate or unsuitable protection as acceptable to Architect.
 - 1. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being painted and in particular, surfaces within storage and preparation area.

- B. Place cotton waste, cloths and material which may constitute fire hazard in closed metal containers and remove daily from site.
- C. Remove electrical plates, surface hardware, fittings and fastenings, prior to painting operations. These items shall be carefully stored, cleaned and replaced on completion of work in each area. Do not use solvent to clean hardware that may remove permanent lacquer finish.
- D. Provide "Wet Paint" signs as required to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

3.8 EXTERIOR PAINTING AND FINISHING SCHEDULE

- A. Non-Ferrous Metal Surfaces (Galvanized, Aluminum):
 - 1. Surfaces Included:
 - a. Galvanized sheet metal (flashing).
 - b. Steel lintels, lintel plates, relieving angles.
 - c. Hollow metal doors and frames, and window-walls.
 - d. Metal handrails, guardrails, ladders.
 - e. Metal gratings.
 - f. Metal roof hatches
 - g. Aluminum.
 - 2. Waterborne System, Low-VOC: Waterborne Acrylic Gloss Enamel over Waterborne Metal Primer.
- B. Ferrous Metal Surfaces (Steel, Iron):
 - 1. Surfaces Included:
 - a. Steel lintels, lintel plates, relieving angles.
 - b. Roof ventilators, roof vents.
 - c. Metal roof stacks.
 - d. Exterior ferrous metal.
 - 2. Waterborne System, Low-VOC: Waterborne Acrylic Gloss Enamel over Waterborne Metal Primer.
- C. Wood Surfaces for Painted Finish:
 - 1. Surfaces Included:
 - a. Plywood fascia.
 - b. Redwood boards and framing.
 - c. Windows, trim, siding, posts, fences, rough sawn lumber.
 - 2. Waterborne System, Low-VOC: 100 percent Acrylic Latex Finishes over 100 percent Acrylic Latex Primer.
- D. Concrete, Precast and Cast-In-Place:
 - 1. Surfaces Included: Walls, beams, columns, posts, ceilings, soffits.
 - 2. Water Based System, Low VOC: 100 percent Acrylic Latex Finish over 100 percent Acrylic Latex Primer.

3.9 INTERIOR PAINTING AND FINISHING SCHEDULE (INTERIOR)

- A. Cast-In-Place Concrete, and Precast Concrete Surfaces:
 - 1. Surfaces Included: Walls, beams, columns, posts, ceilings.
 - 2. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic Finish over Zero-VOC, Low-Odor Acrylic Primer.
 - a. VOC Requirement: Not more than 50 grams VOC's per liter, not less than 35 percent solids, ammonia free coating.
- B. Ferrous and Non-Ferrous Metal Surfaces:
 - 1. Surfaces Included:
 - a. Hollow metal doors and frames.
 - b. Steel stairs, ladders and railings.
 - c. Pre-painted surfaces.

- d. Prime painted hardware.
 - e. Fire extinguisher cabinet trim.
 - f. Radiator, convactor and other heating unit covers.
 - g. Uninsulated piping and ductwork.
 - h. Metal access panels.
 - i. Metal louvers and grilles.
 - j. Electric panels (over factory finish).
 - k. Fire horns.
 - l. Metal supports for counters, benches and shelves.
 - m. Exposed and miscellaneous metals.
 - n. Other exposed to view interior ferrous metals not factory finished.
 - 2. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic over Waterborne Metal Primer; not less than 35 percent solids, ammonia free coating.
 - a. VOC Requirement: Not more than 50 grams VOC's per liter,
- C. Gypsum Wallboard Surfaces:
- 1. Surfaces Included:
 - a. Gypsum wallboard, including over skim coat of joint compound.
 - b. Apply additional coat of primer under deep tone finish paint.
 - 2. Sheens, General: Unless noted otherwise on Room Finish Schedule.
 - a. Walls: Eggshell
 - b. Ceilings and Soffits: Flat
 - c. Walls where indicated on Room Finish Schedule: Semi-gloss.
 - 3. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic Finish over Zero-VOC, Low-Odor Acrylic Primer - not more than 50 grams VOCs per liter, not less than 35 percent solids, ammonia free coating.
 - 4. Waterborne Epoxy System, High Traffic Areas: Waterborne Polyamide Gloss Epoxy Finish over Acrylic Primer/Sealer.
 - 5. Wall Surfaces Under Vinyl Wall Coverings: Primer/Sealer.
- D. Wood Surfaces for Painted Finish:
- 1. Surfaces Included:
 - a. Hardwood rails and benches, except where pre-finish is indicated.
 - b. Millwork, except where pre-finish is indicated.
 - c. Wood doors and frames, except where pre-finish is indicated.
 - d. Plywood shelving.
 - e. Other wood for paint finish.
 - f. Concealed surfaces of wood items to be back-primed.
 - 2. Waterborne Zero-VOC, Low-Odor System: Zero-VOC, Low-Odor Acrylic Finish over Acrylic Latex Wood Primer - not more than 50 grams VOC's per liter, not less than 35 percent solids, ammonia free coating.
- E. Wood Surfaces for Stained and Varnished Transparent Finish:
- 1. Surfaces Included:
 - a. Hardwood handrails and guardrails, except where paint or prefinish is indicated.
 - b. Wood doors and frames, except where paint or prefinish is indicated.
 - c. Laminated wood benches.
 - d. Drawer sides and drawer surfaces concealed in closing position.
 - e. Cabinet interiors.
 - f. Concealed surfaces of wood items to be back-primed with varnish.
 - g. Plywood shelving.
 - h. Other wood for stain and varnish (transparent) finish.
 - 2. Waterborne System: Waterborne Acrylic Finishes over Alkyd Penetrating Stain

3.10 SPECIAL SURFACES

- A. Metal Ceilings:
- 1. Coordinate with Division 05 for shop-applied primer.
 - 2. Surfaces Included:
 - a. Bar joist, decking and supports.

- b. Galvanized ductwork.
 - c. Other overhead metal surfaces.
- 3. Dry Fall Spray-Applied Waterborne Systems: Waterborne Dryfall over Waterborne Metal Primer
- B. Non-Metal Ceilings and Soffits:
 - 1. Surfaces Included:
 - a. Gypsum board assemblies.
 - b. Acoustical tile ceilings.
 - 2. Dry Fall Spray-Applied Waterborne System: Waterborne Dryfall over Waterborne Metal Primer.
- C. Insulation-Wrapped Piping and Equipment:
 - 1. Surfaces Included: Piping, ducts, tanks, and equipment.
 - 2. Waterborne System: Premium Quality Acrylic Latex finish over -Acrylic Primer.
- D. Black Enamel Finish:
 - 1. Surfaces Included: Duct throats for visible distance but not less than approximately 24 inches behind supply or return air grilles, registers, louvers.
 - a. Wood blocking exposed at reveals.
 - 2. Water-Based Systems, Low-VOC: Acrylic Latex Finish.

3.11 REPAINTING OF EXISTING SURFACES

- A. Existing Surfaces: Existing surfaces where indicated to be repainted.
 - 1. Latex System: 2 coats paint type as listed above.

3.12 SMOKE AND FIRE PARTITIONS

- A. Stenciling: Fire walls, fire barriers, fire partitions, smoke barriers and smoke partitions to be stenciled with the appropriate Hour-rating/Minute rating, i.e., "SMOKE and/or FIRE (1 HR /2 HR) – Protect All Openings," etc. as indicated on the Life Safety Plan, above ceilings on both sides of walls in letters not less than 3 inches high and 3/8 inch wide stroke. Refer to IBC Article 703 for additional information.
 - 1. Stenciling shall be located above every door and no more than fifteen feet on center.
 - 2. Stencil every change in direction of rated walls.
 - 3. Indicate the end of a rated wall with a 2-inch vertical red line with an arrow pointing to the direction of the rated wall.
- B. Latex Primer/Finish System: Provide red semi-gloss paint.

END OF SECTION

SECTION 099600 HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Coating and finishing of Architecturally Exposed Metal Fabrication Steel (AES) materials with high performance coatings (HPC), except as specified.
 - 2. Preparation of surfaces for high performance coating and finishing.
- B. Related Sections:
 - 1. Sections 050000 – Division 05 - Metals – Structural Steel Framing: Shop priming for High Performance Coatings.
 - 2. Section 099000 – Painting.

1.2 MOCK-UP

- A. Job Site Sample Areas: Make sample application on project surfaces to extent of 1 system on 1 unit of 1 area as directed by Architect.
 - 1. Obtain acceptance of sample field application before making additional applications.
 - a. Accomplish work to equal or exceed standards established by approved samples.
 - b. Protect and maintain approved field samples through completion of project.
 - 2. High Performance Coating Sample Area: Sample area of project will be selected by Architect to represent typical job surface and condition for application of high performance coating.
 - a. Apply coating in this area in accordance with reviewed color schedule and as specified.
 - b. After sample area is accepted, this area will be used for comparison in evaluation of other high performance coating applications.

1.3 SUBMITTALS

- A. Samples: Submit coating finish samples in accordance with Section 013300, for color selection and finish acceptance.
 - 1. Architect reserves right to select color or finish from manufacturer specified, as necessary, to achieve desired color or finish.
 - a. Mix coating to match chips, where necessary.
 - 2. Schedule: For acceptance, submit 3 copies of complete schedule showing each product by brand name proposed to be used at each surface and location.
 - a. Generally follow specified outline and list number of coats.
 - b. Submit within 30 days after award of contract.
- B. Product Data: Include primers for each coating system specified.
 - 1. Material List: Provide inclusive list of required coating materials.
 - a. Indicate each material and cross-reference specific coating, finish system, and application.
 - b. Identify each material by manufacturer's catalog number and general classification.
 - 2. Manufacturer's Information: Provide manufacturer's technical information, including label analysis and instructions for handling, storing and applying each coating material proposed for use.

1.4 QUALITY ASSURANCE

- A. Single-Source Responsibility: Provide primers and undercoat coating produced by same manufacturer as finish coats.
- B. Compatibility: Provide materials that are compatible with one another and substrates indicated under conditions of service and application, as demonstrated by manufacturer of coating system based on testing and field experience.

- C. Provide protection during removal of existing rust, coatings, or other films from steel. Surface preparation of steel by sanding, scraping or other means may create dust or particles containing lead or other hazardous substances.
 - 1. Protect roofing membrane as required, coordinate with membrane manufacturer.
- D. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of total systems for various substrates.
 - 1. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
- E. Approved Applicator: Applicator shall have not less than 3 years of successful experience in installation of similar coating systems and shall be certified in writing as manufacturer's licensed or approved applicator.
- F. Sheen Types:
 - 1. Manufacturer's standard sheen for specified product.
 - a. Flat: Less than 5 units based on 60 degrees.
 - b. Eggshell: 5 to 20 units based on 60 degrees.
 - c. Satin/Low Luster: 15 to 35 units based on 60 degrees.
 - d. Semi-gloss: 30 to 65 units based on 60 degrees.
 - e. Gloss: Above 65 units based on 60 degrees.
- G. Owner reserves the right to have testing agency test materials used as often as deemed necessary during period when coatings are being applied to ensure that product materials being used comply with specified requirements.

1.5 MAINTENANCE MATERIALS

- A. Leave on premises, where directed by Architect, not less than one unopened gallon of each color used.
- B. Tightly seal containers and clearly label for identification.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver coating materials in sealed original labeled containers, bearing manufacturer's name, type of coating, brand name, color designation and instructions for mixing or reducing.
- B. Provide adequate storage facilities. Store coating materials at minimum ambient temperature of 45 degrees F. in well ventilated area. Restrict storage to coating materials and related equipment.
- C. Take precautionary measures to prevent fire hazards and spontaneous combustion. Comply with health and fire regulations.

1.7 PROJECT CONDITIONS

- A. Environmental Requirements: Comply with manufacturer's recommendations for environmental conditions under which coating and finishing can be applied.
 - 1. Do not apply finish in areas where dust is being generated.
- B. Measure moisture content of surfaces using electronic moisture meter.
 - 1. Do not apply finishes unless moisture contents of surfaces are below manufacturer's maximums.
- C. Ensure surface temperature or surrounding air temperature is between 50 degrees F. and 90 degrees F. before applying finishes.
 - 1. Minimum application temperature for exterior work is 50 degrees F.
- D. Provide adequate continuous ventilation and sufficient heating facilities to maintain temperatures above 45 degrees F. for 24 hours before, during and 48 hours after application of finishes.
- E. Provide minimum 25 foot candles of lighting on surfaces to be finished.

PART 2 - PRODUCTS

2.1 HIGH PERFORMANCE COATINGS

- A. (HPC) High Performance Coatings: Low VOC waterborne aliphatic urethane semi-gloss enamel over polyamide epoxy primer.
- B. Materials: Coating or finish materials selected for each type of surface shall be product of single manufacturer.
- C. Colors: As selected by Architect.

2.2 MIXING AND TINTING

- A. Deliver coatings and enamel ready-mixed to job site. Accomplish job mixing and job tinting only when acceptable. Use tinting colors recommended by manufacturer for specific type of finish.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine surfaces to receive high performance coatings for conditions that would adversely affect execution, permanence or quality of work and which cannot be put into acceptable condition through preparatory work.
 - 1. Do not proceed with surface preparation or coating application until conditions are suitable.

3.2 PREPARATION OF SURFACES

- A. Perform preparation and cleaning procedures in accordance with coating manufacturer's instructions and as specified, for each particular substrate condition.
 - 1. Remove mildew, by scrubbing with solution of detergent, bleach and warm water.
 - a. Rinse with clean water and allow surface to dry completely.
 - 2. Remove surface contamination from aluminum surfaces requiring finish by steam, high pressure water or solvent washing.
 - a. Apply etching primer or acid etch.
 - b. Apply coating immediately if acid etching.
 - 3. Provide barrier coats over incompatible primers or remove and reprime as required.
 - a. Notify Architect in writing of anticipated problems in using specified coating systems with substrate primed by others.
- B. Finishes for steel labeled Architecturally Exposed Steel shall comply with these additional requirements: smooth exposed surface and edges, including welds, by grinding and fill depressions, voids and holes with weld material and/or auto body filler, sand smooth, prime and coat.
- C. Clean surfaces to be coated before applying coating or surface treatment. Remove oil and grease with clean cloths and cleaning solvents prior to mechanical cleaning.
 - 1. Program cleaning and coating so that dust and other contaminants from cleaning process will not fall in wet, newly coated surfaces.
 - a. Apply compatible sealer or primer.
- D. Equipment used for blast cleaning shall be of type that has proper oil and water filters and traps on compressors and/or tanks so that sandblasting material is not being re-contaminated by oil and water in the air blast.
- E. Ferrous Metals: Clean non-galvanized, ferrous surfaces that have not been shop-coated of oil, grease, loose mill scale and other foreign substances by solvent or mechanical cleaning, complying with The Society for Protective Coatings (SSPC)-SP6.
 - 1. Touch-up shop-applied prime coats which have damaged or bare areas. Wire-brush, solvent clean, and touch-up with same primer as shop coat.
 - a. Clean unprimed steel surfaces by washing with solvent. Apply treatment of phosphoric acid solution, ensuring weld joints, bolts and nuts are similarly cleaned.

- b. Prime surfaces to indicate defects. Coat after defects have been remedied.
- c. Sand and scrape shop primed steel surfaces to remove loose primer and rust. Feather out edges to make touch-up patches inconspicuous.
- d. Clean surfaces with solvent. Prime bare steel surfaces. (Prime steel including shop primed steels.)

3.3 MATERIALS PREPARATION

- A. Mix and prepare coating materials and transparent finish materials in accordance with manufacturer's directions.
- B. Store materials not in actual use in tightly covered containers.
 - 1. Maintain containers used in storage, mixing, and application of coating in clean condition, free of foreign materials and residue.
- C. Stir materials before application to produce mixture of uniform density, and as required during application of materials.
 - 1. Do not stir film which may form on surface into material.
 - 2. Remove film and, if necessary, strain material before using.

3.4 APPLICATION

- A. Schedule Coatings: Apply first coat to surfaces that have been cleaned, pre-treated or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
 - 1. Number of coats and film thickness required is the same regardless of application method employed.
- B. Apply high performance coating with brush, roller, spray, or other acceptable practice in accordance with manufacturer's directions.
 - 1. Use brushes best suited for type of material being applied. Use rollers of carpet, velvet back, or high pile sheep wool recommended by coating manufacturer for material and texture required.
 - a. Apply each coat at proper consistency.
 - b. Each coat shall be slightly darker than preceding coat unless otherwise approved by Architect.
 - c. Provide finish coats which are compatible with prime coatings used.
- C. Do not apply succeeding coats until previous coat has completely dried, unless directed otherwise by manufacturer.
 - 1. Sand between each enamel or varnish coat application with fine sandpaper, or rub surfaces with pumice stone where required to produce even, smooth surface in accordance with coating manufacturer's directions.
- D. Apply additional coats when undercoats, or other conditions show through final coat, until coating film is of uniform finish, color and appearance.
 - 1. Give special attention to insure that surfaces, including edges, corners, crevices, welds, and exposed fasteners receive film thickness equivalent to that of flat surfaces.
 - a. Apply each material at not less than manufacturer's recommended spreading rate, to provide total dry film thickness as recommended.
 - b. Apply first-coat material to surfaces that have been cleaned, pre-treated or otherwise prepared for coating as soon as practicable after preparation and before subsequent surface deterioration.
- E. Allow sufficient time between successive coatings to permit proper drying.
 - 1. Do not recoat until coat has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and application of another coat does not cause lifting or loss of adhesion of undercoat.
- F. Prime Coats: Recoat primed and sealed areas where there is evidence of suction spots or unsealed areas in first coat, to assure finish coat with no burn-through or other defects due to insufficient sealing.

- G. Stipple Enamel Finish: Roll and redistribute coating to even and fine texture. Leave no evidence of rolling such as laps, irregularities in texture, skid marks, or other surface imperfections.
- H. Brush Application: Brush-out and work brush coats onto surfaces in even film.
 - 1. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropeyness, or other surface imperfections will not be acceptable.
 - 2. Neatly draw glass and color break lines.

3.5 CLEANING

- A. As work proceeds and upon completion, promptly remove coating where spilled, splashed or spattered.
 - 1. Touch up and restore damaged or defaced coated areas.
- B. During progress of work keep premises free from unnecessary accumulation of tools, equipment, surplus materials and debris.
 - 1. Remove at end of each work day.
- C. Upon completion of work clean coating-spattered surfaces and leave premises neat and clean, to satisfaction of Owner's Representative.

3.6 PROTECTION

- A. Adequately cover or otherwise protect finished work of other trades and other surfaces from coating and damage.
 - 1. Repair damage as result of inadequate or unsuitable protection as acceptable to Owner's Representative.
 - a. Furnish sufficient drop cloths, shields and protective equipment to prevent spray or droppings from fouling surfaces not being coated and in particular, surfaces within storage and preparation area.
 - b. Place cotton waste, cloths and material which may constitute fire hazard in closed metal containers and remove daily from site.
- B. Provide "Wet Paint" signs as required to protect newly coated finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of coating operations.

3.7 FIELD QUALITY CONTROL

- A. Comply with these additional requirements; smooth exposed surface and edges at steel, including welds, by grinding and fill depressions, voids and holes with weld material and/or auto body filler, sand smooth, prime and coat as recommended by coating manufacturer. Apply by brush or spray to provide minimum dry film thickness of 2 mils or as recommended by coating manufacturer. Insure that coating film is complete and undamaged as approved by Owner's Representative.

END OF SECTION

SECTION 102226 OPERABLE PARTITIONS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Movable flat panel partitions (OWS), vinyl fabric clad, individual panels.
 - 2. Ceiling track and ceiling guards.
 - 3. Electric operation.
 - 4. Pass doors, frames and hardware.
 - 5. Pocket storage area doors and hardware.
- B. Related Sections:
 - 1. Section 050000 - Metals: Steel support framing.
 - 2. Section 061000 - Carpentry: Wood blocking and track support blocking.
 - 3. Section 064000 - Architectural Woodwork: Wood trim.
 - 4. Section 092900 - Gypsum Board: Gypsum board enclosure above partition.
 - 5. Division 26 - Electrical: Electrical service including empty conduit from motor controller to switch.

1.2 SUBMITTALS

- A. Shop Drawings and Product Data: Submit in accordance with Section 013300.
 - 1. Submit Product Data describing partition operation, hardware and accessories, colors and finishes available.
 - 2. Submit Shop Drawings describing opening sizes, track layout, details of track and required supports, track loads, adjacent construction and finish trim, stacking sizes, electric operating components and track switching components.
- B. Samples: Submit samples of vinyl fabric finish, indicating quality, color, texture, and weight.

1.3 MAINTENANCE DATA

- A. Submit maintenance instructions in accordance with Section 017800.
- B. Describe recommended cleaning materials and methods, including spot removal procedures.
- C. Describe cleaning materials detrimental to vinyl fabric surface or hardware finish.
- D. Describe maintenance procedures for electric operator and components.

1.4 QUALITY ASSURANCE

- A. Surface Burning of Vinyl Fabric Finish: ASTM E84; flame/fuel/smoke rating of 25/35/50.
- B. Sound Transmission Loss: ASTM E90; minimum STC of 55 tested on 100 sq ft opening.
- C. Limit installed track deflection under load to 1/360.
- D. Manufacturer Qualifications: Firm (material producer) with not less than 3 years of production experience, whose published literature clearly indicated general compliance of products with requirements of this section.
- E. Installer Qualification: Firm specializing in operable partition installation with not less than 2 years of experience in installation of operable partitions similar to those required for this project.
- F. Single Source Responsibility: Provide material produced by single manufacturer of partitions and mounting hardware.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer, brand name, quality or grade. Store materials in original undamaged packages and containers, inside well ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; blocked off ground to prevent sagging and warping. Comply with instructions and recommendations of manufacturer for special delivery, storage and handling requirements.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Operable Partition Type (OWS): Electrically operated partition with STC of 55.

2.2 MATERIALS

- A. Panel Construction: Minimum 3 inches thick; 16 gage thick steel frame members; jambs, and intermediates; acoustic insulation fill; grooved and gasketed astragals for acoustic seal; ball bearing trolley carriers at each panel.
- B. Track: Rolled steel or extruded aluminum section, thickness and support brackets and fasteners designed to support live and dead loads, including steel sub-channel and track connectors.
- C. Accessories: White enameled ceiling or soffit guard, aluminum jamb molding with integral resilient acoustic seal, fittings, and attachments; retractable bottom sweeps, sound seal gaskets; protective edge trim.
- D. Pass Door: Same construction and thickness as panels, equipped with friction latch and flush pull for panic operation.
- E. Storage Pocket Door: Full height at end of partition runs to conceal stacked partition; of same materials, finish, construction, thickness, and acoustical qualities as panels; complete with operating hardware. Hinges with finish to match other exposed hardware.
 - 1. Manufacturer's standard method to secure pocket door in closed position.
- F. Electric Operator: UL approved; 12 inches per second traveling speed; volt as indicated by electrical, phase as required, 60 Hz supply to electric motor as recommended by partition manufacturer; adjustable friction clutch brake actuated by solenoid controlled motor starter; enclosed limit switch; enclosed magnetic reversing starter.
- G. Control Station: Two keyed three button open-stop-close momentary contact type; 24 volt circuit; surface mounted.
- H. Conduit and Outlet Boxes: Concealed in accordance with Division 26 - Electrical.

2.3 FINISH

- A. Vinyl Coated Fabric Finish: FS CCC-W-408, Type III – heavy, mildew resistant polyvinyl chloride finish for improved washability and flame retardance; color selected by Architect from manufacturer's standard range.
- B. Trim Finish: Dark Bronze color.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine site at which partitions will be installed. Do not proceed until unsatisfactory conditions have been corrected.
- B. Confirm track supports are laterally braced, and that floor flatness is within specified tolerances.

3.2 INSTALLATION

- A. Securely attach and laterally brace partition track to building structural members.
- B. Install partition with electric operator, wiring, and controls in accordance with manufacturer's instructions and ASTM E557. Coordinate installation of electric service.
- C. Fit, align, and adjust partition assembly level and plumb with no air leaks; provide smooth operation from stacked to drawn position.
- D. Lubricate bearings and sliding parts; adjust to ensure smooth, easy operation.
- E. Match operable partitions for color and pattern by using partitions from cartons in same sequence as manufactured and packaged, if so numbered. Broken, cracked, chipped or deformed partitions are not acceptable.

3.3 CLEANING

- A. Clean finish surfaces and partition accessories. Avoid use of abrasive cleaners or solutions containing corrosive solvents.
- B. Protect partitions against damage during construction period. Ensure that partitions will be without damage or deterioration at time of Substantial Completion.

3.4 DEMONSTRATION

- A. Demonstrate proper operation and maintenance procedures to Owner's personnel.

END OF SECTION

SECTION 108200 GREEN SCREEN TREILLAGE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes: Trellis panels and accessories.
- B. Related Sections: 329000 PLANTING

1.3 REFERENCES:

- A. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- B. ASTM A82 – Mechanical, Physical and Performance Properties of Carbon Steel Wire
- C. ASTM A641 – Zinc-Coated (Galvanized) Carbon Steel Wire
- D. ASTM A879 – Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface.
- E. ASTM B117 – Operating Salt Spray (Fog) Apparatus.
- F. RAL – German Institute for Quality Assurance and Indication.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data, standard details, and installation instructions.
- B. Shop Drawings: Submit showing sizes critical dimensions, panel layout constraints using a 2 x 2 inch modular grid, and details and locations of accessories.
- C. Color Submittals: Submit coupons 2 x 3/12 inches minimum showing color and texture to be provided.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Minimum 5 years experience manufacturing and supplying trellis structures of the type required for this project.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from damage. Store panels flat. Provide edge protection when strapping is used. Do not apply loads to panel edges.

PART 2 PRODUCTS

2.1 PANELS

- A. Panels shall be rigid, three-dimensional welded wire grid fabricated of 14-gage ASTM A641 galvanized steel wire.
- B. Face Grid: Wires shall be welded at each intersection to form a 2 x 2 inch face grid on the front and back of panels,
- C. Trusses: Face grids shall be separated by bent wire trusses spaced at 2-inch centers and welded to front and back face grids at each truss apex.

- D. Thickness: 2 inches
- E. Length and Width: Provide in 2-inch nominal increments.
- F. Tolerance: 1/8 inch in width and 1/4 inch in length.

2.2 ACCESSORIES

- A. Trim:
 - 1. Fabricate from 20-gage ASTM A879 galvanized steel.
- B. Types:
 - 1. Channel Trim: Thickness of panel x 1/2 inch legs.
 - 2. Angle Trim: 1/2 inch x 1/2 inch legs.
- C. Locations:
 - 1. Corners formed by intersections of panels: Angle type.
 - 2. Top of Treillage Angle type.
 - 3. Side of Treillage Angle type.
 - 4. Bottom of Treillage Angle type.
- D. Clips and Straps: Provide manufacturer's standard types of clips and straps suitable for mounting conditions. Fabricate from ASTM A879 galvanized steel. Adjustable clips shall have 1/4 inch diameter 18-8 stainless steel bolt, washer, and nut.
- E. Plastic Spacers: Provide 1/2 inch thick black Ultra High Molecular Weight polyethylene (UHMW) washers [to hold clips away from mounting surface].
- F. Fasteners for Attachment to Structure:
 - 1. To Concrete or Masonry: 550 lbs.

2.3 FABRICATION

- A. Cut to size.
- B. Weld trim to panels and grind smooth exterior surfaces of welds.
- C. Curve Panels using either "crimp-to-curve" or "cut-to-curve" technique as recommended by manufacturer for diameter of curve and conditions of use.

2.4 FINISHES

- A. Metal components (except fasteners) shall be factory finished after fabrication.
- B. Finish System: pretreat with general purpose, alkaline, water based cleaner / degreaser applied at 240 degrees F. prime with zinc-rich epoxy powder coat. Topcoat with polyester or polyester-urethane powder coat.
- C. Salt Spray Resistance: Finish shall remain rust free when tested 1680 hours in accordance with ASTM B117.
- D. Color: Wrinkle-Textured Black
- E. Touch-Up Paint: Provide high quality, exterior-grade spray paint suitable for conditions of use.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect substrates and conditions affecting work of Section. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install panels plumb and square, centered within area designated for panels, and aligned to maintain modular grid.
- B. Avoid cutting panels in field. Where field cutting is essential, apply touch-up paint to cut edges.
- C. Install securely with fasteners to meet manufacturer's requirements.
- D. Repair bent or damaged panels. If panels cannot be repaired to satisfaction of Resident Engineer, remove from jobsite and replace with new panels.

END OF SECTION

SECTION 122126 ROLLER SHADES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sunscreen roller shades.

1.2 REFERENCES

- A. ASTM G 21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- B. NFPA 70 - National Electrical Code.
- C. NFPA 701 - Fire Tests for Flame-Resistant Textiles and Films.

1.3 SUBMITTALS

- A. Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Styles, material descriptions, dimensions of individual components, profiles, features, finishes and operating instructions.
 - 3. Storage and handling requirements and recommendations.
 - 4. Mounting details and installation methods.
- B. Shop Drawings: Plans, elevations, sections, product details, installation details, operational clearances, and relationship to adjacent work.
- C. Window Treatment Schedule: For all roller shades. Use same room designations as indicated on the Drawings and include opening sizes and key to typical mounting details.
- D. Verification Samples: Shadecloth sample and aluminum finish sample as selected. Mark face of material to indicate interior faces.
- E. Maintenance Data: Methods for maintaining roller shades, precautions regarding cleaning materials and methods, instructions for operating hardware and controls.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Obtain roller shades through one source from a single manufacturer with a minimum of twenty years experience in manufacturing products comparable to those specified in this section.
- B. Installer Qualifications: Installer trained and certified by the manufacturer with a minimum of ten years experience in installing products comparable to those specified in this section.
- C. Fire-Test-Response Characteristics: Passes NFPA 701 small and large-scale vertical burn. Materials tested shall be identical to products proposed for use.
- D. Anti-Microbial Characteristics: 'No Growth' per ASTM G 21 results for fungi ATCC9642, ATCC 9644, ATCC9645.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in factory-labeled packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings and in the Window Treatment Schedule.

1.6 PROJECT CONDITIONS

- A. Environmental Limitations: Install roller shades after finish work including painting is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

- A. Roller Shade Hardware: Manufacturer's standard non-depreciating fifteen year limited warranty.
- B. Standard Shadecloth: Manufacturer's standard three year warranty.

PART 2 PRODUCTS

2.1 ROLLER SHADE TYPES

- A. (WT) Manually Operated Cordless Shades:
 - 1. Mounting: Surface mounted or inside mounted with fascia.
 - 2. Configuration: Single solar shadecloth.
 - 3. Solar Shadecloths:
 - a. Fabric: 1% openness.
 - b. Color: Selected by Architect from manufacturer's standard colors.

2.2 SHADE BAND

- A. Shade Bands: Construction of shade band includes the fabric, the hem weight, hem-pocket, shade roller tube, and the attachment of the shade band to the roller tube. Sewn hems are not acceptable, unless requested by Architect/customer.
 - 1. Hem Pockets and Hem Weights: Fabric hem pocket with RF-welded seams and concealed hem weights. Hem weights shall be of appropriate size and weight for shade band. Hem weight shall be continuous inside the hem pocket. Hem pocket construction and hem weights shall be similar, for all shades within one room.
 - 2. Shade Band and Shade Roller Attachment:
 - a. Use extruded aluminum shade roller tube of a diameter and wall thickness required to support shade fabric without excessive deflection. Roller tubes less than 1.55" (39.37 mm) in diameter for manual shades are not acceptable.
 - b. Provide continuous positive engagement of spring mechanism
 - c. Provide for positive mechanical attachment of shade band to roller tube; shade band shall be made removable / replaceable with 0.625" x 0.3125" extruded ABS guide slats.

2.3 SHADE FABRICATION

- A. Fabricate units to completely fill existing openings from head to sill and jamb-to-jamb, unless specifically indicated otherwise.
- B. Fabricate shadecloth to hang flat without buckling or distortion. Fabricate with trimmed edges to hang straight without curling or raveling.
- C. Fabricate units for manual operation without the use of cords or chains using an internal lift spring completely contained within the shade roller tube.
- D. For railroaded shadebands, provide seams in railroaded multi-width shadebands as required to meet size requirements and in accordance with seam alignment as acceptable to Architect/customer. Seams shall be properly located.

2.4 COMPONENTS

- A. Access and Material Requirements:
 - 1. Provide shade hardware allowing for the removal of shade roller tube from brackets without removing hardware from opening.
 - 2. Use only ABS with UV inhibitors, reinforced vinyl or Styrene based plastics for all plastic components of shade hardware.
- B. Manually Operated, Cordless Hardware and Shade Brackets:
 - 1. Shade Roller:
 - a. Tube: Provide extruded aluminum alloy 6061 or 6063, 1.75" diameter with exterior 0.15" x 0.84" slot for attaching shade fabric using 0.625" x .3125" extruded ABS guide slats to provide horizontal adjustment of shade fabric while preventing removal of fabric after installation.

- b. Lift Mechanism: Inner lift spring shall be constructed of blue spring steel of sufficient thickness to provide positive mechanical engagement through entire operation of shade unit. Drive pins shall be heat-treated 1" x .024" steel.
 - 2. Bottom Rail:
 - a. Bottom Rail: Provide bottom rail constructed of milled wood board with 0.5" OD aluminum end tubes and notched center tube to contain aluminum rod mechanisms and finger clip releases.
 - 1) Finger Clip Release: Provide non-looping, injection molded ABS finger clips. Shall be attached to threaded rod mechanism inside notched center tube.
 - 2) Rod Mechanism: Provide two each per shade unit, 0.25" aluminum rods, custom fit to each shade unit, with removable, adjustable end tips. Shall have one threaded end to attach adjustable end tips.
 - 3) End Tips: Provide injection molded, reinforced nylon end tips press fit into 0.375" x 3.5" aluminum tube. Shall attach to threaded end of rod mechanism to allow for adjustment to exact window size. End tips shall provide lateral resiliency for proper alignment and engagement of track stops. Custom break away upon Architect/customer request.
 - 3. Bracket Plates:
 - a. Provide mounting bracket plates constructed of 18 gauge galvanized steel with embossed drive pin slots, and 0.25" x 0.562" nylon bushing inserts pressed into each idler pin aperture. Shall be corrosion resistant and will not buckle, bend or break under the shear forces created by the roller tension, shade material, or normal operation.
 - 1) Fabric Valance Bracket Plates: Shall have a 0.5" x 2.75" lip for attaching fabric valance.
 - 2) Optional Security Box Bracket Plates: Shall be constructed with 0.75" folded lips for attaching security boxes. Shall receive a baked on coating to match security box color as specified by Architect/customer.
 - 4. Guide Tracks:
 - a. Provide extruded aluminum alloy 6063-T5, 0.5" deep x 0.75" wide, and shall be clear mill track finish or anodized bronze finish. Stops shall be punched from back of track at a downward angle to create level, preset stops in the upward direction and eliminate engagement with nylon guide tips moving in a downward direction. All tracks shall have identical stops for shades to remain level with bottom sill. Track shall be mounted with screw at top, center, and bottom with a 0.25" nylon spacer over top screw to contain guide tips within track.
- C. Valance:
- 1. Security Box: Provide front security box and back plate constructed of corrosion resistant galvanized steel of sufficient thickness to prevent bending or buckling, with a baked on coating. Shall be custom fit to each window opening with folded lips to eliminate exposed edged. Security box and back shall create a sealed unit to prevent access and removal of shade roller. Security box shall be attached to bracket plates using tamper resistant fasteners.
 - a. Security box types:
 - 1) Standard Security Box – SSB
 - 2) Standard Security Box Reduced Depth – SSB RD
 - 3) Angled Security Box – SB5A
 - 4) Angled Security Box Reduced Depth – SB5A RD (includes wooden 5/8" x 5/8" top lip support for mounting)

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect/customer of unsatisfactory preparation before proceeding.

3.2 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.

3.3 INSTALLATION

- A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 0.75" to interior face of glass. Allow proper clearances for window operation hardware.
- B. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.
- C. Clean roller shade surfaces after installation, according to manufacturer's written instructions.
- D. Engage Installer to train Owner's maintenance personnel to adjust, operate and maintain roller shade systems.

3.4 PROTECTION

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

END OF SECTION

SECTION 129300 SITE FURNISHINGS

PART 1 GENERAL

1.1 DESCRIPTION

- A. Furnish and install all site furnishings shown on drawings and specified in accordance with the manufacturer's instructions and as shown on the drawings and as specified.
- B. Related requirement specifications elsewhere:
 - 1. Section 108200, GREEN SCREEN TREILLAGE
 - 2. Section 321300, SITE CONCRETE
 - 3. Section 329000, PLANTING

1.2 REFERENCES

- A. Perform work in accordance with all applicable laws, codes and regulations required by the City and the State of California.
- B. Manufacturer's Instructions:
 - 1. Where required in the Specifications that materials, products, processes, equipment or the like to be installed or applied in accordance with manufacturer's instructions, directions or specifications, or words to this effect, it shall be constructed to mean that said application or installation shall be in strict accordance with printed instructions furnished by the manufacturer of the material for use under conditions similar to those at the job site.
 - 2. All site furnishings shall be anchored or otherwise secured to prevent movement, unless stated otherwise. Provide concrete footings, corrosion resistant clips, etc. as accepted by the Owner's Representative.
- C. Reference Standards:
 - 1. State of California, Business and Transportation Agency, Department of Transportation: "Standard Specifications."
 - 2. Manufacturers' specifications and recommendations.

1.3 COORDINATION

- A. Coordinate items of other trades. Contractor shall be responsible for the proper installation of all accessories embedded in concrete and for the provision of connections, holes, openings, etc., necessary to the execution of the work of the trades.

1.4 SUBMITTALS: SECTION 013300.

- A. Product data for products specified on drawing or listed herein.

PART 2 MATERIALS

2.1 REFER TO DRAWINGS

PART 3 EXECUTION

3.0 GENERAL INSTALLATION

- A. Install manufactured items in accordance with the manufacturer's instruction and as shown in the drawings and as specified herein.

- B. Perform all work in accordance with all applicable laws, codes and regulations required by State of California and the City of Redwood City.
- C. Set all work true and square, plumb and level. Remove and replace any wood that splits during or after erection until acceptance. Keep nailing neatly lined up.
- D. Fabricate wood in as long pieces as practical unless otherwise indicated. End joints shall occur at supports. Keep all work clean, accurately cut, closely fitted and set to the required lines and levels. Blunt exposed edges by sanding or with plane.
- E. Place washer under the head and nut of bolts where same bear on wood, except head of carriage bolt. Drill bolt holes same diameter as bolt.
- F. Size bolts to fit flush with nuts. Countersink nuts and bolts as detailed.
- G. Hammers with scored faces shall not be used in nailing.
- H. Supply all miscellaneous metal units and install as specified herein under the Sections entitled "Miscellaneous Metalwork" and "Galvanizing." Hot-dip galvanize all metal fastenings, angles, etc., after complete fabrication.
- I. Galvanized metal that is cut, damaged or modified after fabrication shall be immediately painted with Zinc-rich paint to prevent rusting.
- J. Touch up paint any damaged surfaces to match original finish as accepted by Owner's Representative.
- K. Set site furniture, level. Provide spacers under furniture to level as specified herein and acceptable to Owner's Representative
- L. Transport, store and handle precast units and manufactured items in a manner to avoid hairline cracks, staining or other damage. Store units free of the ground and protected from mud or rain splashes. Cover units, secure covers firmly, and protect the units from dust, dirt or other staining material.

3.1 Precast Glasscrete-type Planters:

- A. Glasscrete-type planters shall be installed level using non-shrink grout colored to match the color of the precast unit. Following location of precast units and acceptance by Owner's Representative, provide a 6 to 8 inch wide supporting layer of colored grout continuously under the perimeter of the planter units. Finish the supporting grout either flush with the face of the unit or recess 1/2 inch and finish with a flush layer of caulking colored to match the planter.
- B. For planters that drain directly onto the pavement, provide drainage gaps at low sides as required and accepted by Owner's Representative.

3.2 GREENSCREEN TREILLAGE

- A. Install in accordance with the manufacturer's instruction and as shown.

3.3 BENCHES

- A. Install level and in accordance with the manufacturer's instruction and as shown.

3.4 CLEANUP, PER SECTION 017700.

END OF SECTION

SECTION 142100 ELECTRIC TRACTION ELEVATORS

PART 1 - GENERAL

1.1 SUMMARY

- A. Electric traction elevators.
- B. Related Sections:
 - 1. Section 030000 - Concrete
 - 2. Section 055000 - Metal Fabrications: pit ladder, divider beams, and supports for entrances, rails and hoisting beam at top of elevator hoistway.
 - 3. Section 071326 - Self-Adhering Sheet Waterproofing: waterproofing of elevator pit.
 - 4. Division 23 - Mechanical: ventilation and temperature control of elevator equipment areas.
 - 5. Division 26 - Electrical:
 - a. Main disconnects for each elevator.
 - b. Electrical power for elevator installation and testing.
 - c. Disconnecting device to elevator equipment prior to activation of sprinkler system.
 - d. The installation of dedicated GFCI receptacles in the pit and overhead.
 - e. Lighting in controller area, machine area and pit.
 - f. Wiring for telephone service to controller.
 - g. Emergency generator for elevator operation.
 - h. Fire Alarm Systems: The installation of fire and smoke detectors at required locations and interconnecting devices; fire alarm signal lines to contacts in the machine area.
 - i. Telephone Systems: ADAAG-required emergency communications equipment.
- C. Applicable Codes: Comply with applicable building and elevator codes at the project site, including but not limited to the following:
 - 1. ANSI A117.1, Buildings and Facilities, Providing Accessibility and Usability for Physically Handicapped People.
 - 2. ADAAG, Americans with Disabilities Act Accessibility Guidelines.
 - 3. ANSI/NFPA 70, National Electrical Code.
 - 4. ANSI/NFPA 80, Fire Doors and Windows.
 - 5. ASME/ANSI A17.7, Safety Code for Elevators and Escalators.
 - 6. ANSI/UL 10B, Fire Tests of Door Assemblies.
 - 7. Local Building Codes
 - 8. All other local applicable codes.

1.2 SYSTEM DESCRIPTION

- A. Equipment Description: Gen2[®] gearless machine-room less elevator where all components fit inside the hoistway.
- B. Equipment Control: Elevonic[®] Control System.
- C. Drive: Regenerative
- D. Quantity of Elevators: As indicated on Drawings.
- E. Stops : 5.
- F. Openings: Front & rear openings.
- G. Travel (maximum): 46 ft.
- H. Rated Capacity: 4000 lb.
- I. Rated Speed: 150 fpm.
- J. Clear Inside Dimensions: 5'-5 9/16" W x 7'-5 1/2" D
- K. Clear Cab Height: 7'-9" with 5/16" floor recess and 4 LED ceiling.

- L. Entrance Type and Width: Two Speed Doors at 48".
- M. Entrance Height: 7'-0".
- N. Main Power Supply: 208, 220-240, 440-480 or 600 Volts + or - 5% of normal, three-Phase, with a separate equipment grounding conductor. Transformer (by others) required for voltages other than 208, 220-240, 440-480 volts.
- O. Car Lighting Power Supply: 120 Volts, Single-phase, 15 Amp, 60 Hz.
- P. Machine Location: Inside the hoistway at the top of the hoistway.
- Q. Signal Fixtures: Manufacturer's standard with metal button targets (exc. CA).
- R. Controller Location: Machine-Roomless Controller(s) must be in the front wall on the same side as the counterweight, located at the top landing.
- S. Performance:
 - 1. Car Speed: $\pm 3\%$ of contract speed under any loading condition or direction of travel.
 - 2. Car Capacity: Safely lower, stop and hold up to 120% of rated load. (code required).
 - 3. Ride Quality:
 - a. Vertical Vibration (maximum): 20 milli-g
 - b. Horizontal Vibration (maximum): 12 milli-g
 - c. Vertical Jerk (maximum): $4.59 \pm 1.0 \text{ ft./sec}^3$ ($1.4 \pm 0.3 \text{ m/sec}^3$)
 - d. Acceleration/Deceleration (maximum): 2.62 ft./sec^2 (0.8 m/sec^2)
 - e. In Car Noise: 55 – 60 dB(A)
 - f. Stopping Accuracy: $\pm 0.375 \text{ in.}$ ($\pm 10 \text{ mm}$) max, $\pm 0.25 \text{ in.}$ ($\pm 6 \text{ mm}$) Typical
 - g. Re-leveling Distance: $\pm 0.5 \text{ in.}$ ($\pm 12 \text{ mm}$)
- T. Operation:

[Simplex] Simplex Collective Operation: Using a microprocessor-based controller, operation shall be automatic by means of the car and hall buttons. If all calls in the system have been answered, the car shall park at the last landing served.

[OR]

[Duplex] Duplex Collective Operation: Using a microprocessor-based controller, the operation shall be automatic by means of the car and hall buttons. In the absence of system activity, one car can be made to park at the pre-selected main landing. The other (free) car shall remain at the last landing served. Only one car shall respond to a hall call. If either car is removed from service, the other car shall immediately answer all hall calls, as well as its own car calls.

[OR]

[Multi-car] Multi-Car (3 to 4 cars) Operation: Using a microprocessor-based controller, the operation shall be automatic by means of the car and hall buttons. In the absence of system activity, one car can be made to park at the pre-selected main landing. The other (free) cars shall park in multiple zones, changing their location with traffic demands.
- U. Operating Features – Standard
 - 1. Full Collective Operation
 - 2. Anti-nuisance.
 - 3. Fan and Light Protection.
 - 4. Load Weighing Bypass.
 - 5. Independent Service.
 - 6. Full Collective Operation.
 - 7. Firefighters' Service Phase I and Phase II.
 - 8. Top of Car Inspection.
 - 9. Zoned Car Parking.
 - 10. Relative System Response Dispatching.
- V. Operation Features – Optional
 - 1. Zoned Access at Bottom Landing.
 - 2. Zoned Access at Upper Landing.
 - 3. Express Priority Service with key-switch(es).
 - 4. Emergency Hospital Service.

5. Automatic Rescue Operation
6. Automatic Standby Power Operation with Manual Override.

W. Door Control Features:

1. Door control to open doors automatically when car arrives at a landing in response to a normal hall or car call.
2. Elevator doors shall be provided with a reopening device that will stop and reopen the car door(s) and hoistway door(s) automatically should the door(s) become obstructed by an object or person. Door protection shall consist of a two dimensional, multi-beam array projecting across the car door opening.
3. Door nudging operation to occur if doors are prevented from closing for an adjustable period of time.

X. Provide equipment according to seismic zone: [Enter appropriate zone for project: 0, 1, 2, 3, 4]

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's product data for each system proposed for use. Include the following:
1. Signal and operating fixtures, operating panels and indicators.
 2. Cab design, dimensions and layout.
 3. Hoistway-door and frame details.
 4. Electrical characteristics and connection requirements.
 5. Expected heat dissipation of elevator equipment in hoistway (BTU).
 6. Color selection chart for Cab and Entrances.
- B. Shop Drawings: Submit approval layout drawings. Include the following:
1. Car, guide rails, buffers and other components in hoistway.
 2. Maximum rail bracket spacing.
 3. Maximum loads imposed on guide rails requiring load transfer to building structure.
 4. Clearances and travel of car.
 5. Clear inside hoistway and pit dimensions.
 6. Location and sizes of access doors, hoistway entrances and frames.
- C. Operations and Maintenance Manuals: Provide manufacturer's standard operations and maintenance manual.

1.4 QUALITY ASSURANCE

- A. Manufacturer: Elevator manufacturer shall be ISO 9001 certified.
- B. Installer: Elevators shall be installed by the manufacturer.
- C. Permits, Inspections and Certificates: The Elevator Contractor shall obtain and pay for necessary Municipal or State Inspection and permit as required by the elevator inspection authority, and make such tests as are called for by the regulations or such authorities. These tests shall be made in the presence of such authorities or their authorized representatives.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Should the building or the site not be prepared to receive the elevator equipment at the agreed upon date, the General Contractor will be responsible to provide a proper and suitable storage area on or off the premises. Should the storage area be off-site and the equipment not yet delivered, then the elevator contractor, upon notification from the General Contractor, will divert the elevator equipment to the storage area. If the equipment has already been delivered to the site, then the General Contractor shall transport the elevator equipment to the storage area. The cost of elevator equipment taken to storage by either party, storage, and redeliver to the job site shall not be at the expense of the elevator contractor.

1.6 WARRANTY

- A. The elevator contractor's acceptance is conditional on the understanding that their warranty covers defective material and workmanship. The warranty period shall not extend longer than one (1) year from the date of completion or acceptance thereof by beneficial use, whichever is earlier, of each elevator. The warranty excludes: ordinary wear and tear, improper use, vandalism, abuse, misuse, or neglect or any other causes beyond the control of the elevator contractor and this express warranty is in lieu of all other warranties, express or implied, including any warranty of merchantability or fitness for a particular purpose.

1.7 MAINTENANCE AND SERVICE

- A. Maintenance service consisting of regular examinations and adjustments of the elevator equipment shall be provided by the elevator contractor for a period of **[Select the appropriate new installation maintenance period: <three (3)> <six (6)> <nine (9)> <twelve (12)>]** months after the elevator has been turned over for the customer's use. This service shall not be subcontracted but shall be performed by the elevator contractor. All work shall be performed by competent employees during regular working hours of regular working days. This service shall not cover adjustments, repairs or replacement of parts due to negligence, misuse, abuse or accidents caused by persons other than the elevator contractor. Only genuine parts and supplies as used in the manufacture and installation of the original equipment shall be provided.
- B. The periodic lubrication of elevator components shall not be required, including: Sheaves, Rails, Belts, Ropes, Car and CWT guides, etc.
- C. The elevator control system must:
1. Provide in the controller the necessary devices to run the elevator on inspection operation.
 2. Provide on top of the car the necessary devices to run the elevator in inspection operation.
 3. Provide in the controller an emergency stop switch. This emergency stop switch when opened disconnects power from the brake and prevents the motor from running.
 4. Provide in the event of a power outage, means from the controller to electrically lift and control the elevator brake to safely bring the elevator to the nearest available landing.
 5. Provide the means from the controller to reset the governor over speed switch and also trip the governor.
 6. Provide the means from the controller to reset the emergency brake when set because of an unintended car movement or ascending car over speed.
 7. Provide the means from the controller to reset elevator earthquake operation.
- D. Provide system capabilities to enable a remote expert to create a live, interactive connection with the elevator system to enable the following functions:
1. Remotely diagnose elevator issues with a remote team of experts
 2. Remotely return an elevator to service
 3. Provide real-time status updates via email
 4. Remotely make changes to selected elevator functions including:
 - a. Control building traffic: Restrict floor access, remove car from group operation, shut down elevator, select up peak/down peak mode, activate independent service
 - b. Conserve energy: Activate cab light energy save mode, activate fan energy save mode, shut down car(s)
 - c. Improve passenger experience: Extend door open times, change parking floor, activate auto car full, activate anti-nuisance, advance door opening, door nudging, extend specific floor extended opening time, release trapped passengers

PART 2 - PRODUCTS

2.1 DESIGN AND SPECIFICATIONS

- A. Provide machine-roomless Gen2™ traction passenger elevators from Otis Elevator Company. The control system and car design based on materials and systems manufactured by Otis Elevator Company. Specifically, the system shall consist of the following components:

1. Controller located entirely inside the hoistway. No extra machine room or control closet space required.
2. An AC gearless machine using embedded permanent magnets mounted at the top of the hoistway.
3. Polyurethane Coated-Steel Belts for elevator hoisting purposes.
4. Regenerative drive that captures normally wasted energy and feeds clean power back into the building's power grid.
5. LED lighting standard in ceiling lights and elevator fixtures.
6. Sleep mode operation for LED ceiling lights and car fan.

B. Approved Installer: Otis Elevator Company

2.2 EQUIPMENT: CONTROLLER COMPONENTS

- A. Controller: A microcomputer based control system shall be provided to perform all of the functions of safe elevator operation. The system shall also perform car and group operational control.
1. All high voltage (110V or above) contact points inside the controller shall be protected from accidental contact when the controller doors are open.
 2. Controller shall be separated into two distinct halves; Motor Drive side and Control side. High voltage motor power conductors shall be routed so as to be physically segregated from the rest of the controller.
 3. Field conductor terminations points shall be segregated; high voltage (>30 volts DC and 110 VAC,) and low voltage (< 30 volts DC)
 4. Controllers shall be designed and tested for Electromagnetic Interference (EMI) immunity according to the EN 12016 (May 1998): "EMC Product Family Standards for lifts, escalators, and passenger conveyors Part 2 – immunity"
 5. Controller shall be located inside the wall next to the top landing entrance frame. Emergency access shall be provided through an access panel in the entrance frame secured by a key lock.
 6. A separate control room or cabinet should not be required.
- B. Drive: A Variable Voltage Variable Frequency AC drive system shall be provided. The drive shall be set up for regeneration of AC power back to the building grid.

2.3 EQUIPMENT: MACHINE AND GOVERNOR

- A. Machine: AC gearless machine, with a synchronous permanent-magnet motor, dual solenoid service and emergency disc brakes, mounted at the top of the hoistway.
- B. Governor: The governor shall be a tension type car-mounted governor.
- C. Buffers, Car and Counterweight: Polyurethane type buffers shall be used.
- D. Hoistway Operating Devices:
1. Emergency stop switch in the pit.
 2. Terminal stopping switches.
- E. Positioning System: Consists of an encoder, reader box, and door zone vanes.
- F. Guide Rails and Attachments: Guide rails shall be Tee-section steel rails with brackets and fasteners. Side counterweight arrangements shall have a dual-purpose bracket that combines both counterweight guide rails, and one of the car guide rails to building fastening.
- G. Coated-Steel Belts: Polyurethane coated belts with high-tensile-grade, zinc-plated steel cords and a flat profile on the running surface and the backside of the belt. All driving sheaves and deflector sheaves should have a crowned profile to ensure center tracking of the belts. A continuous 24/7 monitoring system using resistance based technology has to be installed to continuously monitor the integrity of the coated steel belts and provide advanced notice of belt wear.
- H. Governor Rope: Governor rope shall be steel and shall consist of at least eight strands wound about a sisal core center.
- I. Fascia: Galvanized sheet steel shall be provided at the front of the hoistway.
- J. Hoistway Entrances:

1. Frames: Entrance frames shall be of bolted construction for complete one-piece unit assembly. All frames shall be securely fastened to fixing angles mounted in the hoistway and shall be of UL fire rated steel.
2. Sills shall be extruded aluminum.
3. Doors: Entrance doors shall be of metal construction with vertical channel reinforcements.
4. Fire Rating: Entrance and doors shall be UL fire rated for 1-1/2 hour
5. Entrance Finish:
 - a. Select finish: < paint> < satin stainless steel> <gold stain> Color to be selected from the manufacturer's color chart.
6. Entrance marking plates: Entrance jambs shall be marked with 4" x 4" plates having raised floor markings with Braille located adjacent to the floor marking. Marking plates shall be provided on both sides of the entrance.
7. Sight Guards: sight guards will be furnished with all doors painted to match with painted doors, painted black for stainless steel and gold satin doors.

2.4 EQUIPMENT: CAR COMPONENTS

- A. Car frame and Safety: A car frame fabricated from formed or structural steel members shall be provided with adequate bracing to support the platform and car enclosures. The car safety shall be integral to the car frame and shall be Type "B", flexible guide clamp type.
- B. Cab **[Select one]**:
 1. Steel Shell Cab with **painted** vertical removable panels
 2. Steel Shell Cab with **laminated** vertical removable panels
 3. Steel Shell Cab with **stainless** steel vertical removable panels
 4. Paints and laminate to be selected from manufacturer's catalog of choices.
 5. Brushed Stainless Steel finished base plate located at top and bottom
- C. Car Front Finish: Satin Stainless Steel.
- D. Car Door Finish: Satin Stainless Steel.
- E. Ceiling Type: **[Select one]**
 1. **[Ceiling]** Flat steel ceiling **[Select: <Real White (EWO)> or <Black (EW5)> or <Brushed Steel Finish>]** with 4 LED lights.
[OR]
 2. **[Drop Ceiling]** Dropped flat steel ceiling **[Select: <Real White (EWO)> or <Black (EW5)> or <Brushed Steel Finish> or <Gold Satin Finish>]** with 6 LED lights.
[OR]
 3. **[Drop Ceiling]** LED Perimeter-lit ceiling **[Select: <Real White (EWO)> or <Black (EW5)> or <Brushed Steel Finish> or <Gold Satin Finish>]**.
- F. Emergency Car Lighting: An emergency power unit employing a 6-volt sealed rechargeable battery and totally static circuits shall be provided to illuminate the elevator car in the event of building power failure.
- G. Fan: A one-speed 120 VAC fan will be mounted to the ceiling to facilitate in-car air circulation, meeting A17.1 code requirements. The fan shall be rubber mounted to prevent the transmission of structural vibration and will include a baffle to diffuse audible noise. A switch shall be provided in the car-operating panel to control the fan.
- H. Handrail: Handrails shall be provided on the **[Select one <side walls> or <rear wall> or <side and rear walls>** of the car enclosure. Handrails shall be 3/8" x 2" (9.5 mm x 51 mm) flat tubular handrail with a Brushed Steel or Gold Satin Finish. **Or** 1 1/2" diameter (38.1 mm) Round bar handrail with a Brushed Steel or Gold Satin Finish **Or** 1" x 1 15/16" (25.4 mm x 48.26 mm) Oval Handrail with a Brushed Steel Finish.
- I. Threshold: Extruded Aluminum **or** Bronze Finish **or** Nickel-Silver Finish.
- J. Emergency Exit Contact: An electrical contact shall be provided on the car-top exit.

- K. Guides: The car shall have 3" diameter roller guides at top and bottom and the counterweight shall have slide type guides at the top and the bottom.
- L. Platform: The car platform shall be constructed of metal. Load weighing device shall be mounted on the belts at the top of the hoistway.
- M. Certificate frame: Provide a Certificate frame with a satin stainless steel finish.
- N. The LED ceiling lights and the fan should automatically shut off when the system is not in use and be powered back up after a passenger calls the elevator and pushes a hall button.

2.5 EQUIPMENT: SIGNAL DEVICES AND FIXTURES

- A. Car Operating Panel: A car operating panel shall be provided which contains all push buttons, key switches, and message indicators for elevator operation. The car operating panel shall have a satin stainless steel finish.

OR

- B. A car operating panel shall be furnished. It shall contain a bank of round stainless steel, mechanical LED illuminated buttons. Flush mounted to the panel and marked to correspond to the landings served. All buttons to have raised numerals and Braille markings with:
 - 1. <Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo or gold satin button with white LED illuminating halo>
 - 2. <1/8" (3mm) satin stainless steel projecting button with blue or white illuminating halo or gold satin button with white illuminating halo>
 - 3. <Vandal-Resistant, Flush satin stainless steel button with blue LED illuminating center jewel>
 - 4. <Lexan 1/8" (3mm) projecting fully illuminated button with white LED> (required by some local California codes)
- C. The car operating panel shall be equipped with the following features:
 - 1. Raised markings and Braille to the left hand side of each push-button.
 - 2. Car Position Indicator at the top of and integral to the car operating panel.
 - 3. Door open and door close buttons.
 - 4. Inspection key-switch.
 - 5. Elevator Data Plate marked with elevator capacity and car number.
 - 6. Help Button: The help button shall initiate two-way communication between the car and a location inside the building, switching over to another location if the call is unanswered, where personnel are available who can take the appropriate action. Visual indicators are provided for call initiation and call acknowledgement.
 - 7. Landing Passing Signal: A chime bell shall sound in the car to signal that the car is either stopping at or passing a floor served by the elevator.
 - 8. In car stop switch (toggle or key unless local code prohibits use)
 - 9. Firefighter's hat.
 - 10. Firefighter's Phase II Key-switch.
 - 11. Call Cancel Button.
 - 12. Car Position Indicator: A digital, LED car position indicator shall be integral to the car operating panel.
- D. Hall Fixtures: Hall fixtures shall be provided with necessary push buttons and key switches for elevator operation. Hall fixtures shall have:

OR

- E. Integral Hall fixtures shall feature round stainless steel, mechanical buttons marked to correspond to the landings. Hall fixtures to be located in the entrance frame face **or** the wall. Buttons shall be in vertically mounted fixture. Fixture shall be satin stainless steel.
 - 1. Button Options:
 - a. <Flat Flush Mounted satin stainless steel button with blue or white LED illuminating halo or gold satin button with white LED illuminating halo>
 - b. <1/8" (3mm) satin stainless steel projecting button with blue or white illuminating halo or gold satin button with white illuminating halo>

- c. <Vandal-Resistant, Flush satin stainless steel button with blue LED illuminating center jewel>
 - d. <Lexan 1/8" (3mm) projecting fully illuminated button with white LED> (required by some local California codes)
- F. Car Lantern and Chime: A directional lantern visible from the corridor shall be provided in the car entrance. When the car stops and the doors are opening, the lantern shall indicate the direction in which the car is to travel and a chime will sound.
- G. **[Optional]** Access key-switch at top floor in entrance jamb.
- H. **[Optional]** Access key-switch at lowest floor in entrance jamb.
- I. **[Optional]** Card Reader Provision
- J. **[Optional, Duplex only]** Emergency (standby) Power key-switch: Manual selection of each elevator in normal operation after automatic return in standby power operation has been initiated.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Take field dimensions and examine conditions of substrates, supports, and other conditions under which this work is to be performed. Do not proceed with work until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- A. Installation of all elevator components except as specifically provided for elsewhere by others.

3.3 DEMONSTRATION

- A. The elevator contractor shall make a final check of each elevator operation with the Owner or Owner's representative present prior to turning each elevator over for use. The elevator contractor shall determine that control systems and operating devices are functioning properly.

END OF SECTION

SECTION 210000 FIRE SUPPRESSION BASIC REQUIREMENTS

PART 1 GENERAL

1.1 DESIGN-BUILD SUMMARY OF WORK

- A. Work Included: 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.

1.2 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.

1.3 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:
 - 1. Refer to individual Division 21, Fire Suppression Sections for fire suppression system design criteria.
- C. Fire Suppression Equipment:
 - 1. Refer to individual Division 21, Fire Suppression Sections for fire suppression equipment requirements.

1.4 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 representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.5 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

1.6 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
- C. Reference standards and guidelines include but are not limited to the latest adopted editions from:
 1. ANSI American National Standards Institute
 2. ASCE American Society of Civil Engineers
 3. ASCE-7 ASCE-7 Minimum Design Loads for Buildings and Other Structures
 4. ASME American Society of Mechanical Engineers
 5. ASPE American Society of Plumbing Engineers
 6. ASTM ASTM International
 7. AWWA American Water Works Association
 8. CFR Code of Federal Regulations
 9. CSA CSA International
 10. ICC International Code Council
 11. ICC-ESR International Code Council Evaluation Service Reports
 12. LEED Leadership in Energy and Environmental Design
 13. NEC National Electric Code

- 14. NFPA National Fire Protection Association:
 - a. NFPA 13 Standard for the Installation of Sprinkler Systems
 - b. NFPA 14 Standard for the Installation of Standpipe and Hose Systems
 - c. NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection
 - d. NFPA 22 Standard for Water Tanks for Private Fire Protection
 - e. NFPA 24 Standard for Installation of Private Fire Service Mains and Their
 - f. NFPA 25 Standard for Inspection, Testing, and Maintenance of Water-Based
 - g. NFPA 70 National Electrical Code
 - h. NFPA 72 National Fire Alarm and Signaling Code
 - i. NFPA 101 Life Safety Code
 - 15. OSHA Occupational Safety and Health Administration
 - 16. UL Underwriters Laboratories Inc.
 - 17. USGBC United States Green Building Council
- D. See Division 21, Fire Suppression individual Sections for additional references.
 - E. 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.
 - F. 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.
 - G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.7 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. 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 portable flash drive or zip file via e-mail. For electronic format, provide one zip file per specification division containing a separate file for each specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
 - 3. General: Submit shop drawings, calculations and product data sheets as one complete stand-alone package to AHJ, Owner's insurance underwriter and Engineer.
 - 4. Product Data: Provide Manufacturer's descriptive literature for products specified in Division 21, Fire Suppression Sections.

5. 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 Item. Highlight connections by/to other trades.
 - b. 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.
 - 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 21, Fire Suppression Sections for additional submittal requirements outside of these requirements.
6. 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.
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 Part 3 of this Section.
8. 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.
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:

- a. 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.
- b. 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.
- c. Provide Shop Drawings which indicate information required by NFPA 13, 14, 20, 22, and 24. Include room names and fire sprinkler occupancy hazard classifications.
- d. Provide Shop Drawings illustrating information for Hydraulic Information Sign for each hydraulic remote area calculated.
- e. Utilizing the Reflected Ceiling backgrounds, provide Shop Drawings illustrating locations of fire sprinklers and piping.
- f. Utilizing the Structural backgrounds, provide Shop Drawings illustrating locations and types of hangers and sway braces.
- g. Provide Shop Drawings illustrating each type of hanger, including fasteners to structure.
- h. 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.
- i. Provide Shop Drawings illustrating information for Sprinkler System General Information Sign.
- j. 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.
- k. When required, provide Coordination Drawings.
- l. Provide Shop Drawings indicating access panel locations, size and elevation for approval prior to installation.
- m. 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.
- n. Provide sway bracing calculations on drawings showing horizontal seismic design load and requirements, with indication of zone of influence for each bracing location.
- o. Provide a schedule of sway bracing type, size, and design criteria, including length, angle from vertical, and load capacities.
- p. Clearly indicate the elevation of the highest sprinkler in relation to the elevation of the flow test pressure gauge monitor hydrant.
- q. Provide details of flexible branch line connectors per manufacturer's schedule of equivalent feet used in hydraulic calculations, showing connector device length, maximum number of 90-degree bends and expected radius of bends.

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. Clearly indicate changes on Drawings and cloud changes in the submittals.
- b. Resubmit for review until review indicates no exceptions taken or make "corrections as noted".

14. Operation and Maintenance Manuals/Owners Instructions:

- a. Submit, at one time, electronic files (PDF format) on CD/DVD 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.
 - 1) Include copies of certificates of code authority acceptance, code-required acceptance tests; test reports and certificates.
 - 2) 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.
 - 3) Catalog description of each Item of equipment actually installed on job.
 - 4) Instructions for operation and maintenance of fire suppression systems composed of operating instructions, maintenance instructions and manufacturer's literature as follows:
 - (a) 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.
 - (b) 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.
 - 5) Include product certificates of warranties and guarantees.
 - 6) Include Record Drawings,
 - 7) Include copy of water supply flow test used as basis for hydraulic calculations.
 - 8) Include hydraulic calculations and sway brace calculations.
 - 9) Include Contractor's Material and Test Certificates for Aboveground Piping/Underground Piping.
 - 10) Include a copy of NFPA 25.
 - 11) Include a copy of valve charts and whether normally open or normally closed.
 - 12) Include a copy of drain, auxiliary, and low point drains charts.
 - 13) 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.
 - 14) 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.
 - 15) Include copy of complete parts list for equipment. Include available exploded views of assemblies and sub-assemblies.
 - 16) Include copy of startup and test reports specific to each piece of equipment.
 - 17) 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 21 00 00, Fire Suppression 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 Item. 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. Invert elevations and dimensioned locations for water services and drainage piping below grade extending to 5-feet outside building line.
- e. 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.
- f. See Division 21, Fire Suppression individual Sections for additional items to include in Record Drawings.

16. Calculations: Submit hydraulic and sway brace and the like calculations.

- a. Hydraulic Calculations:
 - 1) Include friction losses between the hydraulically most remote design area and the hydrant flow test pressure hydrant.
 - 2) 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.
 - 3) Provide one or more hydraulic calculations for each hydraulically most remote area.
 - 4) 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.
 - 5) For grid systems, either provide "peaked" hydraulic calculations, or provide two additional sets of hydraulic calculations for each hydraulically most remote area.
 - 6) Include pressure losses between the highest sprinkler and the elevation of the pressure gauge monitor hydrant of the flow test.
 - 7) 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.
- b. Sway Brace Calculations:
 - 1) 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.

1.8 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.
- B. 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.
- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.

- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- E. Provide products which are UL listed.

1.9 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.

1.10 COORDINATION DOCUMENTS

- A. Prior to construction, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, fire alarm, fire standpipes, fire pump, and fire suppression controllers, plumbing, cable trays, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, electrical, fire alarm, kitchen, and smoke zones ceiling suspension and tile systems, etc.), 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. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.
- B. Prepare Drawings as follows:
 - 1. Provide drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
 - 2. Review and revise, as necessary, Section cuts in Contract Drawings after verification of field conditions.
 - 3. Indicate fire protection system piping including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.
 - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible Item. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings, architectural reflected ceiling drawings and HVAC equipment, ductwork and piping. Drawings to indicate proposed and identified structural members to which hangers and sway braces will be attached as shown on structural drawings.
 - 5. Incorporate Addenda Item and change orders.
 - 6. Provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- D. 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.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.11 LEED REQUIREMENTS

- A. Project seeks LEED certified status, as outlined by the United States Green Building Council (www.usgbc.org).
- B. Obtain list of credits sought by project. Be familiar with requirements for credits. See Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for requirements.
- C. Provide materials and services as outlined in appropriate LEED Reference Guide.
- D. Provide documentation as outlined in appropriate LEED Reference Guide.
- E. Coordinate start-up, testing, training, and installation with Commissioning Agent as required to meet commissioning requirements.
- F. Provide adequate schedule for construction activities such as building flush out.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide like Item from one manufacturer, including but not limited to sprinkler heads, pipe, fittings, hangers and bracing materials.

2.2 MATERIALS

- 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, and ICC-ES approved for their intended fire protection function or have adequate approval or be acceptable by State, County, and City authorities.
- B. Articles, fixtures and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. 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.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.
- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 21, Fire Suppression Sections. In absence of specific requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum of 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.

- 3) Masonry: Karp DSC-214M.
- 4) 2 hour rated: Karp KPF-350FR.
- 5) Manufacturers: Karp, Milcor, Elmdor, Acudor or approved equivalent.

PART 3 EXECUTION

3.1 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. In absence of specific requirements, comply with individual Division 21, Fire Suppression 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 International E814, Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- F. Pipe Installation:
 1. Coordinate work 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. 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:
 1. Provide plenum rated materials that meet the requirements to be installed in plenums. Immediately notify Architect/Engineer of discrepancy.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Section 21 00 00, Fire Suppression Basic Requirements and individual Division 21, Fire Suppression Sections.
- B. Equipment Importance Factor: 1.5.
- C. General:
 - 1. Confirm Building Risk Category and Seismic Design Category with Architect and Structural Engineer.
 - 2. 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 0.5 of equipment operating weight or lateral seismic forces as determined by building code and NFPA 13 calculations, whichever is more demanding.
 - 3. See Structural Drawings for seismic design criteria for sway bracing and seismic restraint.
 - 4. Earthquake resistant designs for Fire Protection (Division 21, Fire Suppression) equipment and distribution, i.e. fire sprinkler systems, fire standpipe systems, fire pumps, fire pump controllers, fire tanks, clean agent fire suppression systems, etc. conform to regulations of jurisdiction having authority.
 - 5. 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.
 - 6. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping, equipment, tanks, pumps controllers and the like. Submit shop drawings along with equipment submittals.
 - 7. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.
 - 8. 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.
- D. Piping: Per NFPA 13, ASCE-7 and local requirements.
- E. 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.

3.3 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.

3.4 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 21, Fire Suppression 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 at a minimum. If overtime is required, there will be no allowance made by Owner for extra expense for such overtime or shift work.
 4. During entire time system, or part thereof, is not operational, provide a firewatch per Fire Code, including a watchperson whose sole duty is to watch for and report fires.
 5. Organize work to minimize duration of power interruption.

3.5 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.

3.6 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.

3.7 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.

3.8 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 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. Training and Demonstration per Division 01 specifications for General Commissioning Requirements.
- E. Prior to acceptance of work and during time designated by Architect, provide necessary qualified personnel to operate system for a period of two hours.
- F. 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.

- G. Upon completion of work and adjustment of equipment, test systems to demonstrate to Owner's Representative and Architect that equipment is furnished and installed or connected under provisions of these Specifications.

3.9 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.

3.10 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.
 - 1. 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 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 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.

3.12 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 21, Fire Suppression Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work. Label access panels with engraved nameplates indicating function of panel.

3.13 DEMOLITION

- A. Confirm Demolition requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Sections in Division 21, Fire Suppression and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to fire protection system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged Item with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - 2. Equipment and Piping: Unless otherwise directed, equipment, piping, or fittings being removed as part of demolition process are Owner's property. Remove other Item not scheduled to be reused or relocated from job site as directed by Owner.
 - 3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
 - 4. Unless specifically indicated on Drawings, remove unused equipment, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).
 - 5. Coordinate demolition of existing fire suppression systems with Contractor. Where applicable or possible, portions of fire suppression demolition work may be performed by Contractor. Verify with local AHJ as to limitations of demolition by others and not fire suppression trades. Coordinate extent of demolition of fire suppression work to be done by others and supervise this work. No extra costs will be approved by replacement of systems due to improper or excessive demolition.

3.14 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

3.15 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.

3.16 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.

3.17 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.

3.18 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 210500 COMMON WORK RESULTS FOR FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Buried Ductile Iron Pipe and Fittings
 - 2. Buried PVC (Polyvinyl Chloride) Pipe and Fittings
 - 3. Joint Restraints
 - 4. Aboveground Black Steel Pipe and Fittings
 - 5. Aboveground Galvanized Steel Pipe and Fittings
 - 6. Seismic Separation Assembly
 - 7. Flexible Sprinkler Hose Assembly
 - 8. Wall and Floor Penetrations and Sleeves
 - 9. Dielectric Unions
 - 10. Switches, Valve Supervisory
 - 11. Switches, Water Detector
 - 12. Hangers and Supports
 - 13. Struts and Strut Clamps
 - 14. Sway Braces and Restraints
 - 15. Anchors and Attachments
 - 16. Pipe Stands
 - 17. Gauges
 - 18. Horns/Strobes
 - 19. Combination Sprinkler - Standpipe Fire Department Connection
 - 20. Valves
 - 21. Post Indicator Valve Assemblies
 - 22. Backflow Prevention Devices
 - 23. Pipe Valve and Fire Protection Equipment Identification
 - 24. Signs
 - 25. Drains

1.2 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 12 00, Fire Suppression Standpipes
 - 8. Section 21 13 00, Fire Suppression Sprinkler Systems

1.3 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.

1.4 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. Provide seismic calculations for any sway brace to be attached to any I-joist according to the specifications of the I-joist manufacturer.

1.5 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, California State Fire Marshal's Building Materials Listing Program, or FM Global Approval Guide, new and of current manufacture.
 - 2. Where pressures are expected to exceed 175 PSI, provide products for high pressure or extra high pressure service.
 - 3. Provide per AHJ requirements.
 - 4. 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.
 - 5. See Section 21 00 00, Fire Suppression Basic Requirements where piping materials are approved for use.
 - 6. 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 and standpipe systems.
 - 7. Products, coatings, packing oils, cutting oils, lubricants, water supply additives, cable, wiring, firestopping materials, pipe, fittings and appurtenances to be chemically compatible with non-metallic pipe.
 - 8. Manufacturers: Unless an item is marked "No substitutions", submit substitution request for materials of other than named manufacturers.
 - 9. 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.

1.6 WARRANTY

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

1.7 FLOW TEST

- A. Flow Test:
1. Flow: _____ GPM at a residual pressure of _____ PSI. .
 2. Static Pressure: _____ PSI. .
 3. Location: _____.
 4. Elevation: _____.
 5. Date: _____.
 6. Information Provided By: _____.
- B. Provide materials and labor for a new water supply test on the closest nearby fire hydrants per NFPA 13 and NFPA 291.

1.8 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

2.1 MANUFACTURERS

- A. Buried Ductile Iron Pipe and Fittings:
1. American Cast Iron Pipe Company
 2. Atlantic States Cast Iron Pipe Company
 3. Clow Water Systems Company
 4. Griffin Pipe Products Company
 5. McWane Cast Iron Pipe Company
 6. Pacific States Cast Iron Pipe Company
 7. United States Pipe & Foundry Company
 8. Star Pipe Products
 9. Or approved equivalent.
- B. Buried PVC (Polyvinyl Chloride Pipe and Fittings):
1. Certainteed Corporation
 2. JM Eagle
 3. National Pipe and Plastics Incorporated
 4. Or approved equivalent.
- C. Joint Restraints:
1. Star Pipe Products
 2. Tyler Pipe Company
 3. EBAA Iron, Incorporated
 4. Uni-Flange Corporation
 5. Union Foundry Company
 6. United States Pipe and Foundry Company
 7. Or approved equivalent.
- D. Aboveground Black Steel Pipe and Fittings:
1. Pipe:
 - a. Allied Tube & Conduit Corporation
 - b. Bull Moose Tube
 - c. Wheatland Tube Company

- d. Youngstown Tube Company
- e. Tex-Tube Company
- f. State Pipe and Supply, Incorporated
- g. 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. Smith-Cooper International
 - b. Anvil International
 - c. Ward Manufacturing
 - d. Aegis Technologies
 - e. Or approved equivalent.
- 4. Fittings, Rubber Gasketed:
 - a. Anvil International
 - b. AnvilStar
 - c. EBAA Iron, Incorporated
 - d. Shurjoint Piping Products, Incorporated
 - e. Smith-Cooper International
 - f. Tyco Fire & Building Products
 - g. Victaulic Company
 - 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. United Brand Fittings
 - b. U.S. Pipe
 - c. Anvil S.P.F.
 - d. Iowa Fittings Company
 - e. Victaulic Groove/Flange Adapter
 - f. Tyco Fire Products; Grinnell Groove/Flange Adapter
 - g. Or approved equivalent.
- E. Aboveground Galvanized Steel Pipe and Fittings:
 - 1. Pipe:
 - a. Allied Tube & Conduit Corporation
 - b. Bull Moose Tube
 - c. Wheatland Tube Company

- d. Youngstown Tube Company
 - e. Tex-Tube Company
 - f. State Pipe & Supply, Incorporated
 - g. 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. Smith-Cooper International
 - b. Anvil International
 - c. Ward Manufacturing
 - d. Or approved equivalent.
- 4. Fittings, Rubber Gasketed:
 - a. Anvil International
 - b. AnvilStar
 - c. Ebaa Iron, Incorporated
 - d. Shurjoint Piping Products Incorporated
 - e. Smith-Cooper International
 - f. Tyco Fire & Building Products
 - g. Victaulic Company
 - 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.
- F. Seismic Separation Assembly:
 - 1. Metraflex Fireloop
 - 2. Unisource Manufacturing Incorporated; Model FireV.
 - 3. Mason Industries
 - 4. Victaulic Vicflex
 - 5. Or approved equivalent.
- G. Flexible Sprinkler Hose Fittings:
 - 1. Flexhead
 - 2. Victaulic Vicflex
 - 3. Or approved equivalent.
- H. Wall and Floor Penetrations and Sleeves:
 - 1. Allied Rubber and Gasket Company, Incorporated, dba ARGCO

2. Fire Protection Products Incorporated
 3. Trumbel Link-Seal
 4. Eaton Crouse-Hinds Link-Seal
 5. Or approved equivalent.
- I. Dielectric Unions:
1. Victaulic
 2. Or approved equivalent.
- J. Switches, Valve Supervisory:
1. Outside Screw and Yoke Valve Supervisory Switch:
 - a. Potter Electric Signal Company
 - b. System Sensor
 - c. Or approved equivalent.
 2. Post Indicator Valve (PIV) Control Valve Supervisory Switch:
 - a. Potter Electric Signal Company
 - b. System Sensor
 - c. Or approved equivalent.
 3. Non-Rising Stem Valve Supervisory Switch:
 - a. Potter Electric Signal Company
 - b. System Sensor
 - c. Or approved equivalent.
 4. Ball Valve Supervisory Switch:
 - a. Potter Electric Signal Company
 - b. System Sensor
 - c. Or approved equivalent.
 5. Angle Valve Supervisory Switch:
 - a. System Sensor
 - b. Or approved equivalent.
- K. Switches, Water Detector:
1. Water Flow Switches:
 - a. Wet Sprinkler Systems:
 - 1) Potter Electric Signal Company
 - 2) System Sensor
 - 3) Or approved equivalent.
 2. Pressure Operated Alarm Switches:
 - a. Wet Alarm Check Valve:
 - 1) Potter Electric Signal Company
 - 2) Or approved equivalent.
- L. Hangers and Supports:
1. Cooper B-Line Tolco
 2. Automatic Fire Control Incorporated, dba Afcon.
 3. Anvil International
 4. ITW Buildex Sammys
 5. Erico International
 6. PHD Manufacturing Incorporated
 7. Or approved equivalent.
- M. 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.
- N. Sway Braces and Restraints:
1. Cooper B-Line Tolco
 2. Automatic Fire Control Incorporated, dba Afcon.
 3. Anvil International
 4. Erico International
 5. PHD Manufacturing Incorporated
 6. Or approved equivalent.
- O. Anchors and Attachments:
1. Cast-In Place Anchors for Hangers:
 - a. Cooper B-Line Tolco; Models 109, 109AF, B2500 with N2500 nut, or B3014 with B3014N nut.
 - b. Automatic Fire Control Incorporated, dba Afcon.
 - c. Erico International
 - d. Or approved equivalent.
 2. Cast-In Place Anchors for Braces:
 - a. Cooper B-Line Tolco; Models B2500 with N2500 nut, or B3014 with B3014N nut.
 - b. Anvil International; Figure 282 with nut.
 - c. Automatic Fire Control Incorporated, dba Afcon.
 - d. Erico International
 - e. Or approved equivalent.
 3. Attachments:
 - a. As specified or described by structural.
 - b. Hilti; Model Kwikbolt TZ
 - c. Powers; Models Snake+, Power Stud+ SD2, or Powers Wedge-Bolt.
 - d. Simpson Strong-Tie
 - e. Or approved equivalent.
- P. Pipe Stands:
1. Cooper B-Line Tolco; Fig B3092 with Fig. B3088ST.
 2. Automatic Fire Control Incorporated, dba Afcon; Model 708 with 722.
 3. Anvil International; Figure 259 with Figure 62 or 63.
 4. Or approved equivalent.
- Q. Gauges:
1. Ashcroft
 2. US Gauge
 3. Brecco
 4. Reliable Automatic Sprinkler Company
 5. Fire Protection Products, Incorporated
 6. Allied Rubber and Gasket Company Incorporated, dba ARGCO
 7. Wika Instrument Corporation
 8. Or approved equivalent.
- R. Horn/Strobes:
1. Horn/Strobes:
 - a. Potter; Model SASH-120.
 - b. System Sensor
 - c. approved Equivalent.

S. Combination Sprinkler-Standpipe Fire Department Connection

1. Guardian Fire Equipment
2. Fire End Croker Corporation
3. Potter-Roemer
4. Elkhart Brass
5. Tyco Fire & Building Products
6. Or approved equivalent.

T. Valves:

1. OS&Y Gate:
 - a. 175 PSI:
 - 1) Nibco
 - 2) Mueller
 - 3) Or approved equivalent.
 - b. 250 PSI:
 - 1) Victaulic
 - 2) Or approved equivalent.
 - c. 350 PSI:
 - 1) Nibco
 - 2) Or approved equivalent.
 - d. 2-inches and Smaller:
 - 1) Nibco
 - 2) Or approved equivalent.
2. NRS Gate:
 - a. 175 PSI:
 - 1) Nibco
 - 2) Or approved equivalent.
 - b. 200 PSI:
 - 1) Mueller
 - 2) Or approved equivalent.
 - c. 250 PSI:
 - 1) Victaulic
 - 2) Or approved equivalent.
3. Swing Check:
 - a. Nibco
 - b. Mueller
 - c. Viking Easy Riser Swing Check.
 - d. Tyco
 - e. AnvilStar
 - f. Or approved equivalent.
4. Wafer Check:
 - a. Nibco
 - b. Mueller
 - c. Viking
 - d. Tyco
 - e. Or approved equivalent.
5. Butterfly Valves:
 - a. Nibco
 - b. Tyco
 - c. Use lug body next to pumps; Nibco.
 - d. Or approved equivalent.
6. Pressure Reducing:
 - a. Cla-Val

- b. Tyco
 - c. Bermad
 - d. Or approved equivalent.
- 7. Pressure Relief:
 - a. Watts
 - b. United Brass Works
 - c. AGF
 - d. Or approved equivalent.
- 8. Automatic Ball Drip Drain Valve:
 - a. Tyco
 - b. Reliable Automatic Sprinkler Company
 - c. Or approved equivalent.
- 9. Solenoid Valve:
 - a. Burkert
 - b. Or approved equivalent.
- 10. Three-Way Gauge Valve:
 - a. Fire Protection Products Incorporated
 - b. Or approved equivalent.
- 11. Automatic Air Release Valve:
 - a. Potter Electric Signal Company
 - b. Or approved equivalent.
- 12. Ball Valve:
 - a. Apollo Valves; 64 Series, 1/4-inch through 2-inches.
 - b. Fire Protection Products Incorporated
 - c. Nibco
 - d. Or approved equivalent.
- U. Post Indicator Valve Assemblies:
 - 1. Vertical Indicator Post for Non-Rising Stem Valve:
 - a. Nibco
 - b. Kennedy Valve
 - c. Mueller
 - d. Viking
 - e. United Water Products
 - f. Or approved equivalent.
 - 2. Horizontal Indicator Post for Non-Rising Stem Valve:
 - a. Nibco
 - b. Kennedy Valve
 - c. Mueller
 - d. Viking
 - e. United Water Works
 - f. Or approved equivalent.
 - 3. Butterfly Valve Indicator Post Assemblies:
 - a. Buried lug/wafer butterfly valve and above grade traveling-nut indicator actuator. Internal supervisory switch. Fail safe spring on post.
 - 1) Nibco
 - 2) Henry Pratt Company
 - 3) Or approved equivalent.
 - b. Grooved butterfly valve with internal supervisory switch, steel wall plate, wall post assembly.
 - 1) Nibco
 - 2) Or approved equivalent.

V. Backflow Prevention Devices:

1. Double Check Valve Assembly:
 - a. Ames
 - b. Febco
 - c. Zurn Wilkins
 - d. Apollo Valves
 - e. Or approved equivalent.
2. Reduced Pressure Principle Backflow Prevention Assembly:
 - a. Ames
 - b. Febco
 - c. Zurn Wilkins
 - d. Or approved equivalent.
3. Vault:
 - a. Utility Vault
 - b. Or approved equivalent.

W. Pipe Valve and Fire Protection Equipment Identification:

1. Fire Protection Products, Incorporated
2. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
3. Or approved equivalent.

X. 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.

Y. Drains:

1. Reference Aboveground Black Steel Pipe and Fittings.
2. AGF
3. Victaulic
4. Or approved equivalent.

2.2 BURIED DUCTILE IRON PIPE AND FITTINGS

- A. Pipe: Class 52 ductile iron, AWWA C151, 150 psi. Cement mortar lined, factory encased with 8 mil polyethylene tube or sheet or seal coat per AWWA C104.
- B. Fittings: AWWA C110, 250 psi. Cement mortar lined. Seal coat: AWWA C104. Double field wrapped with 5 cm, 20 mil vinyl tape, 50 percent overlap, Scotch Wrap No. 51.
- C. Fittings restrained with thrust blocks per NFPA 24.

2.3 BURIED PVC (POLYVINYL CHLORIDE) PIPE AND FITTINGS

- A. Pipe: SDR-18, AWWA C900.
- B. Fittings:
 1. AWWA C907, CSA B137.2.
 2. Fittings restrained with thrust blocks per NFPA 24.
- C. Install tracer wire on all non-metallic underground water lines. Type R.H.W., #10 A.W.G. stranded.

2.4 JOINT RESTRAINTS

- A. Mechanical joint wedge action for ductile iron pipe.
- B. Gland: Ductile Iron.
- C. Wedges: Ductile iron.
- D. Full restraint pressure rating of pipe with minimum safety factor of 2:1.

2.5 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 or Minimum Corrosion Resistance Ratio (CRR) of 1.00 per UL Listing or FM Global Approval. Allied BLT/XL is not permitted.
 - 2. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A53, ASTM A135, or ASTM A795; minimum of Schedule 10 or Minimum CRR of 1.00 per UL Listing or FM Global approval. Wall thickness greater than Schedule 5. Schedule 5 not approved.
 - 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.

2.6 ABOVEGROUND GALVANIZED STEEL PIPE AND FITTINGS

- A. Provide for dry pipe, preaction and deluge systems. Galvanized inside and out with threaded or grooved. Provide galvanized fittings where piping is exposed.
- B. Pipe Size 2-inch Diameter and Smaller: Hot dipped galvanized ASTM A795; ASTM A123. Schedule 40 or Minimum Corrosion Resistance Ratio (CRR) of 1.00 per UL Listing or FM Global Approval. Allied BLT/XL is not permitted.
- C. Pipe Size 2-1/2-inch Diameter and Larger: ASTM A795; minimum of Schedule 10 or Minimum CRR of 1.00 per UL Listing or FM Global Approval. Wall thickness greater than Schedule 5. Schedule 5 not approved.

- D. Exposed pipe 8-feet or less above finished floor: A minimum of Schedule 40.
- E. Joints:
 - 1. Threaded, flanged or bevel welded.
 - 2. Piping installed in plenums or shafts to have welded joints.
- F. 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.

2.7 SEISMIC SEPARATION ASSEMBLY

- A. Flexible expansion loop, designed for seismic movement for sprinkler pipe passing through or crossing building seismic joints. Impart no thrust loads to building structure.
- B. Two flexible sections of hose and braid, two 90 degree elbows and 180 degree return. Factory supplied, center support nut located at the bottom of the 180 degree return, drain/air release plug. Provide materials of construction and end fitting type consistent with pipe material and equipment/pipe connection fittings.

2.8 FLEXIBLE SPRINKLER HOSE ASSEMBLY

- A. Fully welded non-mechanical fittings, braided, leak-tested with minimum 1-inch true-bore internal corrugated hose diameter. 175 psi or 300 psi. Ceiling bracket: galvanized steel, direct attachment type, with integrated snap-on clip ends positively attached to ceiling with tamper-resistant screws and removable flexible hose attachment with set screw. FM1637, UL 2443, ICC-ES AC-156.
- B. Commercial T-Bar Suspended Ceilings: FlexHead, Commercial with T-bar ceiling bracket.
- C. Commercial Drywall Ceilings, FlexHead Commercial with drywall mounting bracket.
- D. Industrial/Ducts: FlexHead with Industrial/Duct mounting bracket.
- E. Cleanrooms: FlexHead Cleanroom model.
- F. Institutional: FlexHead with Institutional mounting bracket.
- G. TechZone: FlexHead with TechZone mounting bracket

2.9 WALL AND FLOOR PENETRATIONS AND SLEEVES

- A. Below Grade and High Water Table Areas: Neoprene gasket links bolted together around an interior sleeve forming a watertight seal.

2.10 DIELECTRIC UNIONS

- A. Provide dielectric unions for transitions between dissimilar metal piping.

2.11 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.

2.12 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).

2.13 HANGERS AND SUPPORTS

- A. General:
 - 1. Select size of hangers and supports to exactly fit pipe size for bare piping.
 - 2. Select size of hangers and supports to exactly fit around piping insulation with saddle or shield for insulated piping.
- B. Hangers:
 - 1. Ferrous. .
- C. Hanger Rods:
 - 1. Concealed Spaces: Continuously threaded or threaded ends.
 - 2. Exposed Spaces: Threaded ends.
- D. Finishes:
 - 1. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
 - 2. Use non-metallic coatings such as plastic, felt, epoxy paint, or non-adhesive isolation tape on attachments for electrolytic protection where attachments are in direct contact with dissimilar metals such as copper tubing.
- E. Materials:
 - 1. Use carbon steel pipe hangers and supports, metal trapeze pipe hangers and attachments for general service applications.
 - 2. Use corrosion-resistant attachments for highly corrosive or hostile environment applications.
 - 3. Use copper coated or plastic coated pipe hangers and copper attachments for copper piping and tubing.
- F. Anti-Scratch Padding: Use padded hangers for piping subject to scratching.

2.14 STRUTS AND STRUT CLAMPS

- A. Electro-galvanized steel.
- B. Designed for supporting pipe runs from strut supports.
- C. UL listed for pipe up to 8-inches in diameter.

2.15 SWAY BRACES AND RESTRAINTS

- A. Sway Bracing: From a single manufacturer and compatible with sway brace calculation program.

2.16 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. Cast in Place Anchors for Hangers:
 - 1. Ferrous.
 - 2. Verify listing is for hangers, braces, or both.
- C. 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.
 - 3. See Structural Drawings for additional information regarding acceptable attachments. Attachment products listed in structural Drawings and Specifications take precedence over the following products. If no structural Drawings or Specification provided, choose from the following: Hilti Kwikbolt TZ, Powers - Snake+, Powers Power-Stud+SD2 or Powers Wedge-Bolt.
- D. 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.

2.17 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.

2.18 GAUGES

- A. Pressure Gauges: 3.5-inch, dial type, bronze bourdon tube or spring type, stainless steel case. 0 to 600 PSI.

2.19 HORN/STROBES

- A. Exterior Alarm Bells: Minimum weatherproof backbox, typical 90 dBA at 10-feet.
- B. Interior Alarm Bells: Standard square electrical backbox, typical 90 dBA at 10-feet.

2.20 COMBINATION SPRINKLER-STANDPIPE FIRE DEPARTMENT CONNECTION

- A. Thread to match fire department hardware; automatic drip connected to drain; threaded dust cap and chain of same material and finish as body. or Fire Department required and approved Knox caps.
- B. Type:
 - 1. Standard Wall Type
 - 2. Flush-Mounted Wall Type

- 3. Free-Standing Type
- C. Finish:
 - 1. Ductile Iron
 - 2. Brass
 - 3. Chrome-Plated
- D. Inlet Size: 2-1/2-inch.
- E. Number of Inlets: Four.
- F. Outlet Size: 6-inch.
- G. Size of Pipe between Fire Department Connection and Standpipe System: 6-inch.
- H. Drain: 3/4-inch automatic ball drip.
- I. Sign:
 - 1. Combination Manual Standpipe-Auto Sprinkler Fire Department Connection
 - 2. _____ PSI Required at FDC Inlet to Meet System Demand

2.21 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 Reducing: Iron body, pilot-operated.
- G. Pressure Relief: Bronze body, stainless steel spring.
- H. Automatic Ball Drip Drain Valve: Bronze, spring-type.
- I. Solenoid Valve: Direct-acting. Brass body with stainless steel seat. Duty cycle, 100 percent continuous with mounting bracket and screws, with cable plug.
- J. Three-Way Gauge Valve: Brass; rated to 300 psi.
- K. 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.
- L. Ball Valves: Brass body, brass stem; forged brass ball disc.

2.22 POST INDICATOR VALVE ASSEMBLIES

- A. Vertical Indicator Post for Non-Rising Stem Valve:
 - 1. Indicates if valve is in open or shut position.
 - 2. Telescoping barrel type.
 - 3. Fixed length type.

4. Flanged base.
 5. Mount for padlock.
 6. Mount for supervisory switch.
- B. Horizontal Indicator Post for Non-Rising Stem Valve:
1. Indicates if valve is in open or shut position.
 2. Used to operate a valve installed behind a wall.
 3. With a post flange to mount on a wall.
 4. Operated by a handwheel.
 5. Cast iron body.
 6. Mount for padlock.
 7. Mount for supervisory switch.
- C. Butterfly Valve Indicator Post Assemblies:
1. Buried lug/wafer butterfly valve and above grade traveling-nut indicator actuator. Internal supervisory switch. Fail safe spring on post.
 2. Grooved butterfly valve with internal supervisory switch, steel wall plate, wall post assembly.

2.23 BACKFLOW PREVENTION DEVICES

- A. Double Check Valve Assembly:
1. Two check valves in series with OS&Y gate or butterfly valves at each end.
 2. Provide detector if required by local utility.
 3. UL listed or FM Global Approved for fire suppression service as an assembly.
 4. Approved by local and state authorities, including project's State Department of Health for the position in which it is installed.
- B. Reduced Pressure Principle Backflow Prevention Assembly:
1. OS&Y gate valves on inlet and outlet with indentation for monitoring switch and strainer on inlet.
 2. Two independent operating, spring-loaded check valves with a pressure differential relief valve located between the two checks valves.
 3. Relief valve air gap drain funnel.
 4. Provide detector if required by local utility.
 5. UL Listed or FM Global approved for fire suppression service as an assembly and approved by local authorities and project's State Department of Health.
- C. Utility Vault:
1. Precast concrete underground sized to enclose the backflow prevention device and the fire department connection check valve, with adequate clearance around these Item to allow maintenance.
 2. Drain sump in vault bottom, suitable for insertion of a sump pump.
 3. Sump Pump
 4. Gravity Drain
 5. Drain piping to approved discharge locations as required by local code officials.
 6. Costs for electrical connections and wiring as required for a complete and operable system.
 7. Provide watertight electrical penetrations. Provide piping penetrations with rubber links which seal watertight by tightening compression bolts, or equivalent watertight pre-manufactured pipe penetration system.
 8. Provide vault extensions as required for proper depth and round personnel access with cover and stainless steel or aluminum permanent ladder.

- D. Provide Water Bureau approved Bypass-Meter and compatible Touch-Pad. Touch-Pad unit must be accessible from right-of-way.

2.24 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.

2.25 SIGNS

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

2.26 DRAINS

- A. Reference Aboveground Black Steel Pipe and Fittings.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

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

3.2 BURIED DUCTILE IRON PIPE AND FITTINGS

- A. Pipe Sleeves:
 - 1. 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 firestopping, smokestopping and water stopping grout or approved equivalent caulking compound. Provide "Link-Seal" sleeve sealing system for slab on grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies.
 - 3. Wall Sleeves: Provide "Link-Seal" sleeve sealing system for wall penetrations passing through concrete or masonry construction below grade. Provide sleeves on pipes. Provide sleeve flush with finished face of wall. Caulk pipes passing through walls with nonshrinking 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. 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.
- B. Buried Pipe:
 - 1. Hydraulically calculated pipe to be of sufficient size as to deliver the required flow while not exceeding a flow velocity of 15-feet per second or as required in accordance with the water department requirements, whichever is less.
 - 2. Excavation and Backfill:
 - a. General: Perform necessary excavation and backfill required for installation of mechanical work. Repair piping or other work damaged by Contractor's operations.
 - b. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.
 - c. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of a testing laboratory.

- d. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (i.e. muck, peat and the like), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material at no expense to Owner. Adequate width of trench for proper installation of piping or conduit.
- e. Support Foundations:
 - 1) Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to a depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Sections of Specifications or Drawings.
 - 2) Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
 - 3) Foundation Material: Where native material has been removed, place and compact necessary foundation material to form a base for replacement of required thickness of bedding material.
 - 4) Bedding Material: Full bed site piping on sand, pea gravel or 3/4-inch minus crushed rock. Place a minimum 4-inch deep layer of sand or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide a firm foundation.
- f. Backfilling:
 - 1) Following installation and successful completion of required tests, backfill piping in lifts.
 - (a) In "Pipe Zone," place backfill material and compact in lifts not to exceed 6-inches in depth to a height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
 - (b) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.
 - 2) Backfill Material:
 - (a) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
 - (b) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."
- g. Compaction of Trench Backfill:
 - 1) Where compaction of trench backfill material is required, use one of following methods or combination thereof:
 - (a) Mechanical tamper,
 - (b) Vibratory compacter, or
 - (c) Other approved methods appropriate to conditions encountered.
 - 2) Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

3.3 BURIED PVC (POLYVINYL CHLORIDE) PIPE AND FITTINGS

- A. Securely fasten tracer wire to top of water line and place along the outside of transition to ductile iron pipe with one foot of slack placed adjacent to ductile iron pipe.
- B. Buried Pipe:
 - 1. Hydraulically calculated pipe to be of sufficient size as to deliver the required flow while not exceeding a flow velocity of 15-feet per second or as required in accordance with the water department requirements, whichever is less.

2. Excavation and Backfill:
- a. General: Perform necessary excavation and backfill required for installation of mechanical work. Repair piping or other work damaged by Contractor's operations.
 - b. Water: Keep excavations free of standing water. Re-excavate and fill back excavations damaged or softened by water or frost to original level with sand, crushed rock or other approved material at no expense to Owner.
 - c. Tests: During progress of work for compacted fill, Owner reserves right to request compaction tests made under direction of a testing laboratory.
 - d. Trench Excavation: Excavate trenches to necessary depth and width, removing rocks, unstable soil (i.e. muck, peat and the like), roots and stumps. Excavation material is classified as "base fill" and "native." Base fill excavation material consisting of placed crushed rock may be used as backfill above "Pipe Zone." Remove and dispose off site native excavation material at no expense to Owner. Adequate width of trench for proper installation of piping or conduit.
 - e. Support Foundations:
 - 1) Foundations: Excavate trenches located in unstable ground areas below elevation required for installation of piping to a depth which is determined by Architect as appropriate for conditions encountered. Place and compact approved foundation material in excavation up to "Bedding Zone." Dewatering, placement, compaction and disposal of excavated materials to conform to requirements contained in other Sections of Specifications or Drawings.
 - 2) Over-Excavations: Where trench excavation exceeds required depths, provide, place and compact suitable bedding material to proper grade or elevation at no additional cost to Owner.
 - 3) Foundation Material: Where native material has been removed, place and compact necessary foundation material to form a base for replacement of required thickness of bedding material.
 - 4) Bedding Material: Full bed site piping on sand, pea gravel or 3/4-inch minus crushed rock. Place a minimum 4-inch deep layer of sand or crushed rock on leveled trench bottom for this purpose. Remove bedding to necessary depth for piping bells and couplings to maintain contact of pipe on bedding for its entire length. Provide additional bedding in excessively wet, unstable, or solid rock trench bottom conditions as required to provide a firm foundation.
 - f. Backfilling:
 - 1) Following installation and successful completion of required tests, backfill piping in lifts.
 - (a) In "Pipe Zone," place backfill material and compact in lifts not to exceed 6-inches in depth to a height of 12-inches above top of pipe. Place backfill material to obtain contact with entire periphery of pipe, without disturbing or displacing pipe.
 - (b) Place and compact backfill above "Pipe Zone" in layers not to exceed 12-inches in depth.
 - 2) Backfill Material:
 - (a) Backfill Material in "Pipe Zone": 3/4-inch minus crushed rock, sand or pea gravel.
 - (b) Crushed rock, fill sand or other backfill material approved elsewhere in Specifications may be used above "Pipe Zone."
 - g. Compaction of Trench Backfill:
 - 1) Where compaction of trench backfill material is required, use one of following methods or combination thereof:
 - (a) Mechanical tamper,
 - (b) Vibratory compacter, or
 - (c) Other approved methods appropriate to conditions encountered.
 - 2) Architect to have right to change methods and limits to better accommodate field conditions. Compaction sufficient to attain 95 percent of maximum density at optimum moisture content unless noted otherwise on Drawings or elsewhere in Specifications. Water "puddling" or "washing" is prohibited.

3.4 JOINT RESTRAINTS

- A. Install per manufacturer's instructions and recommendations.
- B. Reference 3.01, General Installation Requirements.

3.5 ABOVEGROUND BLACK STEEL PIPE AND FITTINGS

- A. Pressure 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. In areas visible to public, route and install pipe so as to minimize visual impact.
 - 4. 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.
 - 5. Except where pre-approved by architect, 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.
 - 6. Route non-preaction piping around areas protected by preaction sprinkler systems.
- 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. Install piping in concealed spaces above finished ceilings. Prior to design and installation, obtain pre-approval by Architect for exposed piping.
 - 3. 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.
 - 4. Coordinate support of pipe 4-inches and larger with Structural Engineer.
 - 5. Provide clearances around piping per NFPA 13.
 - 6. 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.
 - 7. 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. Within equipment rooms, provide minimum 3-foot lateral clearance from sides of electric switchgear panels. Do not route piping above electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such Item.
 - 8. Route water filled and dry system piping around, not into or through, rooms protected by pre-action systems, clean-agent systems, gaseous suppression systems and other alternative fire suppression systems.

9. Install piping as close as possible to ceiling to avoid conflicts with other trades.
10. Install pipe runs to minimize obstruction to other work.
11. Pitch pipe for dry system piping located or passing through warm as well as cold areas.
12. Install 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.

3.6 ABOVEGROUND GALVANIZED STEEL PIPE AND FITTINGS

A. Pressure 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. In areas visible to public, route and install pipe so as to minimize visual impact.
4. 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.
5. 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.

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. Install piping in concealed spaces above finished ceilings.
3. 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.
4. Coordinate support of pipe 4-inches and larger with Structural Engineer.
5. Provide clearances around piping per NFPA 13.
6. 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.
7. 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. Within equipment rooms, provide minimum 3-feet lateral clearance from sides of electric switchgear panels. Do not route piping above electric power or lighting panel, switchgear, or similar electric device. Coordinate with electrical and coordinate exact pipe routing to provide proper clearance with such item.
8. Route water filled and dry system piping around, not into or through, rooms protected by pre-action systems, clean-agent systems, gaseous suppression systems and other alternative fire suppression systems.

9. Install piping as close as possible to ceiling to avoid conflicts with other trades.
10. Install pipe runs to minimize obstruction to other work.
11. Pitch pipe for dry system piping located or passing through warm as well as cold areas.

3.7 SEISMIC SEPARATION ASSEMBLY

- A. Provide four-way sway braces upstream and downstream within 6-feet of the seismic separation assembly, attached to structure on opposite sides of the seismic joint. Do not attach bracing to seismic separation assembly.

3.8 FLEXIBLE SPRINKLER HOSE ASSEMBLY

- A. For hydraulic calculations, include friction loss per manufacturer's schedule of equivalent feet.
- B. When flexible sprinkler hose fittings are added to an existing system, provide hydraulic calculations verifying the design flow rate will be achieved.

3.9 WALL AND FLOOR PENETRATIONS AND SLEEVES

- A. Escutcheons:
 1. Install on exposed pipes passing through walls or floors.
 - a. Pipe Sleeves:
 - 1) Lay out work in advance of pouring concrete and furnish and set sleeves necessary to complete work.
 - b. Floor Sleeves:
 - 1) 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. Provide "Link-Seal" sleeve sealing system for slab on grade. Caulk/seal piping passing through fire rated building assembly with UL rated assemblies. Provide fire-rated assemblies per local AHJ requirements.
 - c. Wall Sleeves:
 - 1) 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.
 - d. Beam Sleeves:
 - 1) 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.
 - 2) Firestopping penetrations in fire-rated wall/floor assemblies.
 - 3) Reference Division 07, Thermal and Moisture Protection.
 - 4) 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.
 - 5) 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.
 - 6) Install firestopping material complete as directed by manufacturer's installation instructions. Meet requirements of ASTM E814.

3.10 DIELECTRIC UNIONS

- A. Comply with manufacturer's instructions for installing unions wherever piping of dissimilar metals are adjoined. Install unions in manner which will prevent galvanic action and inhibit corrosion.

3.11 SWITCHES, VALVE SUPERVISORY

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

3.12 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.

3.13 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.
- B. Space pipe hangers no more than 4-feet on center for exposed sprinkler pipe located 8-feet or less above finished floor.
- C. Limit branch line overhangs to 4-inches or less.

3.14 STRUTS AND STRUT CLAMPS

- A. Install per manufacturer's listed orientation.

3.15 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.

3.16 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: Support piping and equipment from malleable iron concrete form inserts placed before concrete is poured.
 - 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.

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.

3.17 PIPE STANDS

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

3.18 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.

3.19 HORN/STROBES

- A. Locate exterior horn/strobes at 8-feet above finished grade. Coordinate with Architect.
- B. Coordinate with Divisions 26, Electrical and Division 28, Electronic Safety and Security.

3.20 COMBINATION SPRINKLER-STANDPIPE FIRE DEPARTMENT CONNECTION

- A. Locate with sufficient clearance from walls, obstructions, or adjacent siamese connectors to allow full swing of fire department wrench handle.
- B. Provide method of draining FDC piping. Drain to sanitary sewer by indirect connection, or to exterior where damage, including damage to landscaping and staining of concrete, will not occur.
- C. Locate away from building egress paths. Coordinate location with Fire Marshal.

3.21 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.
 3. Provide an isolating gate valve near the connection of the private water service main to the city water main.
- 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. Installation of Check Valves:
 - a. Swing Check Valves: Install in horizontal position with hinge pin horizontally perpendicular to centerline of pipe. Install for proper direction of flow.
 - b. 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.
- D. Pressure Reducing/Regulating Valves:
 1. Provide separate, supervised, control valve on each side of pressure regulating valve.
 2. Provide pressure gauge on each side of pressure reducing and pressure regulating valves.

- E. Valve Sequencing:
1. Provide fire-alarm-supervised sectional control/isolation valves so that areas of the sprinkler system can be left in operation while providing isolation in the demolition areas.
 2. Sequence demolition with installation of new supplies to future phasing. Provide temporary supplies where piping serving a later phase runs through an area of an earlier phase. Sequence with architectural and structural phasing plans.

3.22 POST INDICATOR VALVE ASSEMBLIES

- A. Install plumb and conveniently and accessibly located with reference to finished building for repairs, removal and service.
- B. Provide post indicator on buried control valves. Orient so "Open" and "Shut" signs are visible from street, or as required by AHJ.

3.23 BACKFLOW PREVENTION DEVICES

- A. Install conveniently and accessibly located with reference to finished building for repairs, removal and service.
- B. Provide listed backflow assembly at sprinkler system water source connection. Coordinate with local utility; conform to their installation requirements.
- C. Provide method of forward flow testing at full system demand without dismantling any part of the system or at 150 percent of fire pump rating, whichever is greater. Indicate location and method of testing on submittal and As-Built Drawings. Provide signage as required by NFPA 13. Locate drainage for forward testing where damage will not occur, including damage to landscaping.
- D. Reduced Pressure Backflow Preventer:
 1. Locate within 5-feet of finished floor near drain shown on Plumbing Drawings or an existing drain of sufficient size which can accept full discharge of relief valve without doing damage or arrange and pay for installation of a suitable size drain.
 2. Provide drain piping to sanitary sewer. Coordinate with Division 22, Plumbing.

3.24 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. Provide signs for the following general categories of equipment and operational devices: Valves, drains, pumps, standpipes, tanks and similar equipment. Provide valve tag on every valve and control device in each piping system. Exclude check valves and valves within factory fabricated equipment units. List each tagged valve in valve schedule for each piping system.
- B. Each new piece of equipment to bear a permanently attached identification plate, listing manufacturer's name, capacities, sizes and characteristics.
- C. Piping to bear the manufacturer's name, schedule of thickness, size and ASTM identification number
- D. Provide valve tag on every valve and control device in each piping system. Exclude check valves and valves within factory fabricated equipment units. List each tagged valve in valve schedule for each piping system.
- E. Drain, Auxiliary Drain and Drum Drips: Provide valve tag on every valve in each fire suppression system. List each tagged valve and its location in valve schedule, identify on fire suppression drawings.
- F. Install framed, glass or rigid transparent plastic covered, mounted valve schedule and valve location drawing in main riser or fire pump room.
- G. Provide identification sign on ceiling tile below valve location.

- H. Provide permanent identification sign at pressure regulating valves stating required setting of pressure regulator.
- I. Adjusting: Relocate fire suppression identification device which has become visually blocked.
- J. Cleaning: Clean face of identification devices and glass frames of valve charts.

3.25 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. Aisle Width Planned
 - 5. Commodity Classification
 - 6. Encapsulation of Pallet Loads
 - 7. Presence of Solid Shelving
 - 8. Flow Test Data
 - 9. Presence of Flammable/Combustible Liquids
 - 10. Presence of Hazardous Materials
 - 11. Presence of Other Special Storage
 - 12. Location of Auxiliary Drains and Low Point Drains
 - 13. Original Results of Main Drain Flow Test
 - 14. Name of Installing Contractor or Designer
 - 15. 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.

3.26 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 211200 FIRE SUPPRESSION STANDPIPES

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Fire Suppression Hose Valves
 - 2. Roof Hydrant Connections
 - 3. Hydraulic information signs
- B. This is a contractor designed system. Contact AHJ prior to bid and provide required fire system components as prescribed by governing codes as interpreted by AHJ.
- C. Scope: Hydraulically Calculated Combination Sprinkler Riser and Class I Manual Wet Standpipe System.

1.2 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
 - 7. Section 21 13 00, Fire Suppression Sprinkler Systems

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

- A. Submittals as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. Provide hydraulic calculations for the standpipe system.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 21 00 00, Fire Suppression Basic Requirements and Division 01, General Requirements.
- B. System Test:
 - 1. Hydrostatically test entire system in accordance with NFPA 14.
 - 2. Test to be Witnessed by:
 - a. Fire Marshal
 - b. AHJ
 - c. Owner's Insurance Underwriter
 - d. Engineer

1.6 WARRANTY

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

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Suppression Hose Valves:
 - 1. Potter Roemer
 - 2. Guardian Fire Equipment
 - 3. Fire End & Croker Corporation
 - 4. Or approved equivalent.
- B. Roof Hydrant Connections:
 - 1. Potter Roemer
 - 2. Guardian Fire Equipment
 - 3. Fire End & Croker Corporation
 - 4. Or approved equivalent.
- C. Hydraulic Information Signs:
 - 1. Tyco Fire Products
 - 2. Reliable Automatic Sprinkler
 - 3. Viking Corporation
 - 4. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 5. Fire Protection Products, Inc.
 - 6. Or approved equivalent.

2.2 FIRE SUPPRESSION HOSE VALVES

- A. Non Adjustable Type with Cap and Chain on Hose Outlet
- B. 2-1/2-inches Nominal Size with 1-1/2-inch Reducer
- C. 300 PSIG Working Pressure
- D. Thread to match fire department hardware.
- E. Threaded cap and chain of same material and finish.

2.3 ROOF HYDRANT CONNECTIONS

- A. Free-Standing Type
- B. Ductile Iron Finish
- C. 2-1/2-inch Size
- D. 300 PSIG Working Pressure
- E. Thread to match fire department hardware.
- F. Threaded cap and chain of same material and finish.
- G. Sign marked "Manual Standpipe for Fire Department Use Only."

2.4 HYDRAULIC INFORMATION SIGNS

- A. Plastic laminate or corrosion resistant metal.
- B. Corrosion-resistant chain or permanent adhesive.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Connect wet standpipe system to water source ahead of domestic water connection.
- B. Provide additional drains as required to achieve proper drainage of the standpipe system.
- C. Provide connection for alarm and supervisory control to building alarm system.
- D. For each connection from a standpipe that is part of a combined system to a sprinkler system, provide an individual control valve and check valve of the same size as the connection. If the control valve is a combination type pressure regulating that acts as a check valve, provide a separate isolating control valve between the pressure regulating device and the standpipe system.

3.2 FIRE SUPPRESSION HOSE VALVES

- A. Provide additional drains as required to achieve proper drainage of the standpipe system.
- B. Locate hose valves on intermediate level landings of stairwells.
- C. Locate valves in cabinets that are not located in stairwells.
- D. Where residual pressure exceeds 100 PSI at any 1-1/2-inch hose connection, provide a pressure reducing valve to prevent the residual pressure at the connection at the required flow from exceeding 100 PSI.
- E. Where static pressure exceeds 175 PSI, provide a pressure reducing valve to prevent the static and residual pressures at the outlet of the hose connection to 100 PSI for 1-1/2-inch hose connections and 175 PSI for 2-1/2-inch connections.
- F. Hose Valve Connections: Locate with sufficient clearance from walls and obstructions so as to not interfere with the prompt use of the hose connection, hose and other equipment at the time of fire.

3.3 ROOF HYDRANT CONNECTIONS

- A. Locate with sufficient clearance from walls and obstructions so as to not interfere with the prompt use of the hose connection, hose and other equipment at the time of fire event.

3.4 HYDRAULIC INFORMATION SIGNS

- A. Locate at water supply control valve for automatic or semiautomatic systems.
- B. Include the Following Information:
 - 1. Location, design flow rate and design residual inlet and outlet pressures for the two hydraulically most remote hose connections.
 - 2. Design static pressure and design system demand (flow and residual pressure) at the system control valve,
 - 3. Design static pressure and design system demand (flow and residual pressure) at the pump discharge flange.
 - 4. Design static pressure and design system demand (flow and residual pressure) at each fire department connection.

END OF SECTION

SECTION 211300 FIRE SUPPRESSION SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Sprinklers
 - 2. Flexible Sprinkler Hose Assembly
 - 3. Oversized Sprinkler Escutcheons
 - 4. Riser Manifold
 - 5. Floor Control Assembly
 - 6. Floor Control Valve and Test Assembly
 - 7. Inspector's Test Connection
 - 8. Sectional Control Test/Drain Unit
- 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:
 - 1. Wet-Pipe Sprinkler System.
 - 2. Private fire service main, including connection to existing utility and piping to the inlet connection inside the building. Provide required valves, backflow preventer, vaults and appurtenances.
 - 3. Floor control stations, at each floor at the point of connection to the riser, controlling sprinklers on that floor. Floor control stations consist, at a minimum, of an indicating, supervised control valve, flow switch, pressure gauge, inspector's test connection and check valve.
 - 4. Seismic Separation Assembly.
 - 5. Trash or Linen Chute Sprinklers.
 - 6. Future Tenant Improvement: Provide capped tees on a maximum spacing of 150 SF per tee. Tees are to provide for future tenant improvements.
- 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.

1.2 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
 - 7. Section 21 12 00, Fire Suppression Standpipes

1.3 REFERENCES AND STANDARDS

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

1.4 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 assembly, including number and radius of bends, corresponding to equivalent feet used in hydraulic calculations.
 - 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. When flexible sprinkler hose fittings are added to an existing system, provide hydraulic calculations verifying the design flow rate will be achieved.
 - 9. For Future Tenant Improvement Spaces: Include in hydraulic calculations friction loss allowances for future installation of flexible sprinkler head connectors so flexible connectors may be installed in the future without revisions to the overhead system.

1.5 QUALITY ASSURANCE

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

1.6 WARRANTY

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

1.7 SYSTEM DESCRIPTION

- A. Provide coverage for all buildings. 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. Provide fire pump with Code-required appurtenances and electrical requirements for complete and working water supply system if results of water supply test and hydraulic calculations indicate need for a booster pump. Provide design and installation based on more stringent requirement if AHJ requirements differ from Code.
- C. Design Parameters:
 - 1. Increase remote design area for sloped roofs and concealed areas per NFPA 13.
 - 2. Building Areas: Offices, Residential, Institutional Spaces, Locker Rooms, Assembly Spaces.
 - a. Occupancy Classification: Light.
 - b. Inside Hose Allowance: 0 GPM.
 - c. Outside Hose Allowance: 100 GPM.
 - 3. Building Areas: Utility, Storage.
 - a. Occupancy Classification: Ordinary Group 1.
 - b. Inside Hose Allowance: 0 GPM.
 - c. Outside Hose Allowance: 250 GPM.

4. Building Area: Maintenance Shops.
 - a. Occupancy Classification: Ordinary Group 2.
 - b. Inside Hose Allowance: 0 GPM.
 - c. Outside Hose Allowance: 250 GPM.
- D. Sprinkler system design to include a 10 percent pressure and flow cushion between system demand point and available water supplies.
- E. Extend hydraulic calculations from hydraulically most remote design area back to location of pressure hydrant or flow test or effective point of water supply where characteristics of water supply are known.
- F. Develop cost-effective designs that may include use of extended coverage sprinklers and design area reductions as allowed by NFPA 13.

1.8 EXTRA STOCK

- A. Provide extra sprinklers per code.
- B. Provide suitable wrenches for each sprinkler type and metal storage cabinet in riser room.
- C. Inside the cabinet, provide a list of sprinklers installed in the property, including sprinkler identification number, manufacturer, model, orifice, deflector type, thermal sensitivity and pressure rating, quantity of each type to be contained in the cabinet and issue or revision date of the list.

1.9 CONTROL VALVES

- A. Sprinkler system control valves to be post indicator valves located minimum of 40-feet from building.
- B. Sprinkler system control valves to be wall-post indicator valves.
- C. Sprinkler system control valves to be OS&Y or butterfly valves located inside building in a room with outside door.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Sprinklers:
 1. Finished Areas:
 - a. Viking
 - b. Tyco
 - c. Reliable
 - d. Victaulic
 - e. Globe
 - f. Or approved equivalent.
 2. Nonfinished Areas:
 - a. Viking
 - b. Tyco
 - c. Reliable
 - d. Victaulic
 - e. Globe
 - f. Or approved equivalent.
 3. Residential Sprinklers:
 - a. Viking
 - b. Tyco
 - c. Reliable
 - d. Victaulic
 - e. Or approved equivalent.

- 4. Institutional Sprinklers:
 - a. Tyco Raven
 - b. Viking
 - c. Reliable
 - d. Victaulic
 - e. Or approved equivalent.
- B. Flexible Sprinkler Hose Assembly:
 - 1. Flexhead Industries
 - 2. SprinkFLEX
 - 3. Allied Rubber and Gasket Company, Incorporated, dba ARGCO
 - 4. Reliable Automatic Sprinkler Company
 - 5. Tyco Fire and Building Products
 - 6. Victaulic
 - 7. Or approved equivalent.
- C. Oversized Sprinkler Escutcheons:
 - 1. Viking Corporation; Expansion Plate
 - 2. Tyco Fire Protection Products; Wide Adapter Plates
 - 3. Reliable Automatic Sprinkler; Extender Rings
 - 4. Victaulic; FireLock Expansion Plates
 - 5. Globe Fire Sprinkler Corporation; Seismic Escutcheons
 - 6. Or approved equivalent.
- D. Riser Manifold:
 - 1. Viking
 - 2. Reliable
 - 3. AGF
 - 4. Or approved equivalent.
- E. Floor Control Assembly:
 - 1. Viking
 - 2. Victaulic
 - 3. Reliable
 - 4. Or approved equivalent.
- F. Floor Control Valve and Test Assembly:
 - 1. Viking
 - 2. Tyco
 - 3. Victaulic
 - 4. Or approved equivalent.
- G. Inspector's Test Connection:
 - 1. Combination Test and Drain:
 - a. AGF
 - b. Victaulic
 - c. Or approved equivalent.
 - 2. Dry System Inspector's Test Connection:
 - a. AGF
 - b. Or approved equivalent.
 - 3. Remote Combination Test and Drain:
 - a. AGF
 - b. Or approved equivalent.

H. Sectional Control Test/Drain Unit:

1. Tyco
2. Or approved equivalent.

2.2 SPRINKLERS

A. Finished Areas:

1. Type: Glass-Bulb
2. Style: Recessed
3. Response: Quick-Response
4. Finish: White Polyester
5. Escutcheon: White Polyester
6. Coverplate for Concealed Sprinklers:
 - a. Flat Plate
 - b. White

B. Nonfinished Areas:

1. Type: Glass-Bulb
2. Response: Quick-Response
3. Finish: Brass

C. Residential Sprinklers:

1. Type: Glass-Bulb
2. Style: Concealed
3. Response: Quick-Response
4. Finish: White Polyester
5. Escutcheon: White Polyester
6. Coverplate for Concealed Sprinklers:
 - a. Chrome
 - b. White

D. Institutional Sprinklers:

1. Type: Solder Link
2. Style: Concealed
3. Response: Standard Response
4. Finish:
 - a. Chrome
 - b. White Polyester
5. Escutcheon:
 - a. Chrome
 - b. White Polyester

2.3 FLEXIBLE SPRINKLER HOSE 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.

2.4 OVERSIZED SPRINKLER ESCUTCHEONS

- A. Metal.

- B. Provide oversized ceiling penetrations and oversized sprinkler escutcheons for pendent sprinklers to comply with Building Code and ASCE-7 seismic requirements.
- C. Same manufacturer as sprinklers.

2.5 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.

2.6 FLOOR CONTROL ASSEMBLY

- A. Water-flow alarm, gauge, integral pressure relief valve connected to drain, sight glass, smooth bore orifice union of same size as smallest orifice sprinkler installed.

2.7 FLOOR CONTROL VALVE AND TEST ASSEMBLY

- A. Control valve, water-flow alarm, sight glass, smooth bore orifice union of same size as smallest orifice sprinkler installed.

2.8 INSPECTOR'S TEST CONNECTION

- A. Combination Test and Drain:
 - 1. 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.
 - 2. Provide with locking plate, lock and two keys.
- B. Remote Combination Test and Drain:
 - 1. 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. 24 Volt DC or 120 Volt AC; 300 PSI solenoid valve.
 - 2. Provide with locking plate, lock and two keys.

2.9 SECTIONAL CONTROL TEST/DRAIN UNIT

- A. ASTM A53 pipe, with inspector's test valve, Sectional drain valve, Sectional isolation valve with tamper switch, restriction union with corrosion resistant orifice equivalent to sprinkler orifice, sight flow connection and waterflow detector.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

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

3.2 SPRINKLERS

- A. Center sprinklers in center 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. Comply with sprinkler layouts as shown in Construction Documents to meet architectural constraints. These may be more conservative than code maximums. Notify architect if layout does not meet Code requirements.
- D. Install dry sprinklers in a manner which does not trap water.
- E. For Freezers, Coolers and Similar Dry Penetrations: Provide an insulating "boot" manufactured for use with the particular dry sprinkler installed. Do not use spray-on or other insulating methods around dry sprinkler penetrations.

3.3 FLEXIBLE SPRINKLER HOSE ASSEMBLY

- A. Install with no more bends than are included in equivalent footage used in hydraulic calculations.
- B. Maintain manufacturer's recommended bending radius as included in equivalent footage used in hydraulic calculations.

3.4 OVERSIZED SPRINKLER ESCUTCHEONS

- A. Coordinate oversized sprinkler escutcheons with ceiling construction and sprinkler style.

3.5 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.

3.6 FLOOR CONTROL ASSEMBLY

- 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. Provide connection from pressure relief valve to drain.
- D. Install with supervised control valve(s) and check valve.

3.7 FLOOR CONTROL VALVE AND TEST ASSEMBLY

- A. Locate in an area so as to minimize visual impact.
- B. Provide connection to drain.
- C. Pipe pressure relief valve to drain.

3.8 INSPECTOR'S TEST CONNECTION

- A. Locate where full flow discharge will not do damage, including damage to landscaping.
- B. Locate within 5-feet of finished floor.

3.9 SECTIONAL CONTROL TEST/DRAIN UNIT

- A. Locate for ease of access and viewing without ladders or other equipment.

END OF SECTION

SECTION 220000 PLUMBING BASIC REQUIREMENTS

PART 1 GENERAL

1.1 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.

1.2 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.

1.3 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.
- D. 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.

1.4 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Design Criteria:
 - 1. Size storm, waste, water and vent piping in accordance with State Plumbing code and local jurisdiction requirements.
 - 2. Storm and waste piping to be routed at 1/4-inch per foot slope unless specifically noted otherwise. Obtain approval from local authorities for piping with slope less than 1/4 per foot.
 - 3. Size domestic water piping with a maximum pressure drop of 2 PSI per 100 feet and a maximum velocity of 6 feet per second for hot and cold water. For hot water return calculate maximum velocity no greater than 4 ft/second. Provide service per UPC fixture unit calculation. Piping mains inside building to be above ceiling.
 - 4. Provide rough-in and connections for waste, water and vents for fixtures. Coordinate actual location of rough-in with Contractor and Architect.
 - 5. Connect storm drain piping from roof drains or gutters to site storm piping. See Architectural and Civil Drawings for locations. Coordinate exact location of site piping.
 - 6. Provide overflow drain system and terminate at location coordinated with Architect and AHJ. See Architectural and Civil Drawings for locations. Coordinate exact location of site piping.
 - 7. Provide hose bibbs and piping where shown on Drawings. Provide shutoff valve in branch piping to hose bibb.
 - 8. Provide pressure-reducing station on incoming water supply, where service pressure exceeds 80 PSI static. Provide unions, strainers and drain valves.
 - 9. Provide acoustical components/methods for plumbing systems installation coordinated with Project Acoustical Engineer.

B. 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 and Greywater Harvesting Calculations
 - g. Hot Water Heater Calculations

1.5 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 representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 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
- C. Related products/systems located in Division 23, HVAC:
 1. Section 23 11 13 - Facility Fuel - Oil Piping and Systems

1.7 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. General: 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 Canadian Gas Association
 - 15. CISPI Cast Iron Soil Pipe Institute
 - 16. CSA CSA International
 - 17. ETL Electrical Testing Laboratories
 - 18. EPA Environmental Protection Agency
 - 19. FM FM Global
 - 20. IAPMO International Association of Plumbing and Mechanical Officials
 - 21. GAMA Gas Appliance Manufacturers Association
 - 22. HI Hydraulic Institute Standards
 - 23. ISO International Organization for Standardization
 - 24. LEED Leadership in Energy and Environmental Design
 - 25. MSS Manufacturers Standardization Society
 - 26. NEC National Electric Code
 - 27. NEMA National Electrical Manufacturers Association
 - 28. NFGC National Fuel Gas Code
 - 29. NFPA National Fire Protection Association
 - 30. NSF National Sanitation Foundation
 - 31. OSHA Occupational Safety and Health Administration

- 32. SMACNA Sheet Metal and Air Conditioning Contractors' National Association, Inc.
- 33. UL Underwriters Laboratories Inc.
- 34. USGBC United States Green Building Council

- D. See Division 22, Plumbing individual Sections for additional references.
- E. 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.
- F. 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.
- G. Piping Insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.8 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 Exceptions 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 or posted to ftp site. For electronic format, provide one zip file per specification division containing a separate file for each specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
 - 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. 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 220548, Vibration and Seismic Controls for Plumbing Piping and Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Part 3 of this Section.
- 7. 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.
- 8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
- 9. 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.
- 10. 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.
- 11. Samples: Provide samples when requested by individual Sections.
- 12. 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 exceptions 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.
- 13. Operation and Maintenance Manuals, Owners Instructions:
 - a. Submit, at one time, electronic files (PDF format) on CD/DVD 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.
14. 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.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.

- B. 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.
- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- E. UL Compliance: Provide products which are UL listed.
- F. 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.
- G. 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, prepare and submit coordinated layout drawings (composite drawings) to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), 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. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.
- B. Prepare Drawings as follows:
 - 1. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
 - 2. Review and revise, as necessary, Section cuts in Contract Drawings after verification of field conditions.
 - 3. Indicate plumbing system piping including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor.
 - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.

5. Incorporate Addenda items and change orders.
 6. Distribute drawings to trades and provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
 - D. 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.
 - E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.12 LEED REQUIREMENTS

- A. Project seeks LEED certified status, as outlined by the United States Green Building Council (www.usgbc.org).
- B. Obtain list of credits sought by project. Be familiar with requirements for credits. See Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for requirements.
- C. Provide materials and services as outlined in appropriate LEED Reference Guide.
- D. Provide documentation as outlined in appropriate LEED Reference Guide.
- E. Coordinate start-up, testing, training, and installation with Commissioning Agent as required to meet commissioning requirements.
- F. Provide adequate schedule for construction activities such as building flush out.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide like items from one manufacturer, including but not limited to fixtures, pumps, drains and equipment.

2.2 MATERIALS

- 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. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. 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.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.

- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 22, Plumbing Sections. In the absence of specific requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Milcor, Elmdor, Acudor, or approved equivalent.

PART 3 EXECUTION

3.1 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. Coordinate work 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. 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.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Section 220548, Vibration and Seismic Controls for Plumbing Piping and Equipment, Section 22 00 00, Plumbing Basic Requirements and individual Division 22 Plumbing Sections.
- B. Equipment Importance Factor: 1.0.
- C. General:
1. Confirm Building Risk Category and Seismic Design Category with Architect and Structural Engineer.
 2. Earthquake resistant designs for Plumbing (Division 22, Plumbing) equipment and distribution, i.e. motors, plumbing systems, piping, equipment, water heaters, boilers, etc. conform to regulations of jurisdiction having authority.
 3. 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.
 4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
 5. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.
- D. Piping:
1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- E. Equipment:
1. Provide means to prohibit excessive motion of plumbing equipment during earthquake.

3.3 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. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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 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.
- D. Training and Demonstration per Division 01 specifications for General Commissioning Requirements.

3.9 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 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements in Division 01, General Requirements, comply with individual Division 22, Plumbing Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work. Label access panels with engraved nameplates indicating function of panel.

3.13 DEMOLITION

- A. Confirm Demolition requirements in Division 01, General Requirements and Division 0. In absence of specific requirements, comply with individual Sections in Division 22, Plumbing and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to plumbing system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve underground utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - 2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.
 - 3. Unless specifically indicated on Drawings, remove exposed, unused piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap piping and patch surfaces to match surrounding finish.
 - 4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.14 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

3.15 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.

3.16 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.

3.17 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 220513 COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Motor Construction and Requirements
 - 2. Low Voltage Control Wiring
 - 3. Control Cable
 - 4. Disconnects

1.2 SUBMITTALS

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

1.3 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. Field Installed Motors: Installed motors to be of single type, from one source and from a single manufacturer.
 - 2. Variable Frequency Drives: Materials and installation for a complete adjustable frequency motor drive consisting of a pulse width modulated (PWM) inverter for use on a standard NEMA Design B induction motor. Design drive specifically for variable torque applications. Variable Frequency Drive (VFD) provided by equipment manufacturer.
 - a. A firm engaged in the production of this type of equipment for a minimum of 10 years.
 - b. Testing: Test printed circuit boards and burned in before being assembled into the completed VFD. Subject VFD to a preliminary functional test, minimum 8-hour burn-in, and computerized final test at 104 degrees F at full rated load.
 - c. Qualifications:
 - 1) UL Listed.
 - 2) C-UL listed or CSA approved.
 - 3) Warranty: 12 months from the date of certified start-up. Include parts, labor, travel time, and expenses.

1.4 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. For motors 50 HP and Larger: Provide five year manufacturer's limited warranty from date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Motors:
 - 1. Lincoln Motors
 - 2. A.O. Smith Electrical Products

3. Baldor Electric (Reliance Electric)
 4. General Electric
 5. Toshiba
 6. Exceptions: Motors integral to equipment efficiency listing (EER, COP, etc.) per listing agency.
 7. Or approved equivalent.
- B. Low Voltage Control Wiring:
1. General Electric
 2. Anaconda
 3. Rome
 4. Or approved equivalent.

2.2 GENERAL

- A. Electrical components and materials to be UL to ETL listed/labeled as suitable for location and use.
- B. Wiring installed in conduit.

2.3 GENERAL MOTOR CONSTRUCTION AND REQUIREMENTS

- A. Electrical Service: Power wiring from source to motor termination under Division 26, Electrical. Coordinate location of disconnect and starter or motor controller. Combination starter/disconnects may be used in lieu of separate items.
- B. Electrical Service - Unless otherwise noted in the Contract Documents, the following voltage and phase characteristics apply to motors:
 1. Motors 1/2 HP and Under: 120 volt, 1 phase.
 2. Motors 3/4 HP and Over: 208 volt, 3 phase.
 3. Motors 3/4 HP and Over: 480 volt, 3 phase
- C. Construction:
 1. Open drip-proof type except where specifically noted otherwise.
 2. Design for continuous operation in 104 Degrees F 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. 1.25 for motors associated with shaft pressurization system fans. 1.35 for single phase motors.
 6. Noise Rating: Quiet.
 7. Efficiency: Provide premium efficiency motors.
 8. 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
- D. Explosion-Proof Motors: UL approved and labelled for hazard classification with over temperature protection.
- E. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked rotor amps, frame size, manufacturer's name and model number, service factor, power factor, efficiency.
- F. 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.
- G. Provide inverter ready motors per NEMA MG1-30 for variable speed drive or soft-start starter use. Provide shaft grounding for motors over 2 HP serving variable speed drives. Provide shaft grounding and insulated bearings on motors 25 HP and larger serving variable speed drives. Shielded cable required for power wiring from variable speed drive to motor connection.
- H. Unless otherwise indicated, motors 1-HP and larger to meet/exceed NEMA Premium Efficiency and latest EPACT.
- I. Vertical in-line pump motors per NEMA MG1, Motors and Generators.

2.4 LOW VOLTAGE CONTROL WIRING

- A. General 60 Hz Control Circuiting: 600 volts insulated 14 gauge, Type THHN, color coded, installed in conduit in mechanical rooms and exposed locations. In other areas, plenum rated cable is allowed. Reference Division 26, Electrical Specifications for details of wiring and conduit.

2.5 CONTROL CABLE

- A. Wire: Multiple pair, No. 18 gauge minimum conductor size cable with an abrasion and damage resilient outer jacket suitable for exposed installation, cable to be UL approved at 250 or labeled 300 volt insulated and conform with codes, ordinances, rules and standards applicable.
- B. Wire Supports for Wiring Installed Without Raceways: Nylon cable ties, bridle rings or cable clip with metal or plastic base plates applied to structure with construction adhesive or mastic; dedicated support wires attached from the structure members.
- C. Cabling for VFD's: Provide shielded cable for power wiring from VFD to motor. UL 1277, Type TC-ER cable. Houston Wiring, Belden or approved equivalent.

2.6 DISCONNECTS

- A. Provided by Division 26, Electrical unless specified otherwise.

END OF SECTION

SECTION 220516 EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Flexible Pipe Connectors, Steel Piping
 - 2. Flexible Pipe Connectors, Copper Piping
 - 3. Flexible Expansion Loop (for Thermal and Seismic Applications), Steel Piping
 - 4. Flexible Expansion Loop (for Thermal and Seismic Applications), Copper Piping

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements. Include items listed below.
- B. In addition, provide:
 - 1. Shop drawings for review and approval by Engineer. Illustrate Design Data and Expansion Joints items below on the Shop Drawing Submittal.
 - 2. Design Data: Indicate selection calculations.
 - 3. Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.
 - 4. Project Record Documents: Record installed locations of flexible pipe connectors, expansion joints, anchors, and guides.

1.5 QUALITY ASSURANCE

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

1.6 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

2.1 MANUFACTURERS

- A. Flexible Pipe Connectors, Steel Piping:
 - 1. Metraflex Company
 - 2. Mason
 - 3. Hyspan
 - 4. Or approved equivalent.

1. Metraflex Company
 2. Mason
 3. Hyspan
 4. Or approved equivalent.
- C. Flexible Expansion Loop (for Thermal and Seismic Applications), Steel Piping:
1. Metraflex Company
 2. Mason
 3. Hyspan
 4. Or approved equivalent.
- D. Flexible Expansion Loop (for Thermal and Seismic Applications), Copper Piping:
1. Metraflex Company
 2. Mason
 3. Hyspan
 4. Or approved equivalent.

2.2 FLEXIBLE PIPE CONNECTORS - STEEL PIPING

- A. 304 stainless steel, close pitch, annular corrugated hose.
- B. Exterior Sleeve: Double braided (for higher pressure systems), 304 stainless steel.
- C. Pressure Rating: 125 psi at 70 degrees F for 12-inch pipe (single braid) or 165 psi at 70 degrees F for 12-inch pipe (double braid) with a 4 to 1 safety factor..
- D. Joint: ANSI Class 150 carbon steel flanges.
- E. Size: Use pipe sized units.
- F. Maximum Offset: 3/4 inch on each side of installed center line.
- G. Basis of Design: Metraflex Model MLP.

2.3 FLEXIBLE PIPE CONNECTORS - COPPER PIPING

- A. Inner Hose: Bronze, close pitch, annular corrugated hose.
- B. Exterior Sleeve: Braided bronze (piping over 2-inches to be 3 pound braided stainless steel).
- C. Pressure Rating: 125 PSI at 70 degrees F with a 4 to 1 safety factor.
- D. Joint: Sweat ends.
- E. Size: Use pipe sized units.
- F. Maximum offset: 3/8-inch on each side of installed center line.
- G. Basis of Design: Metraflex Model BBS.

2.4 FLEXIBLE EXPANSION LOOP (FOR THERMAL AND SEISMIC APPLICATIONS) - STEEL PIPING

- A. Construction: Two flexible Sections of hose and braid, two 90 degree elbows and a 180 degree return designed so piping does not change direction but maintains course along a single axis. Use Vee Loop where space is limited. System to import no thrust loads to system support anchors or building structure.
- B. Inner Hose: 304 stainless steel, close pitch, annular corrugated hose.
- C. Exterior Sleeve: Single braided, 304 stainless steel.
- D. Pressure Rating: 125 PSI at 70 degrees F with a 4 to 1 safety factor.

- E. Joint: ANSI Class 150 carbon steel flanges.
- F. Size: Use pipe sized units.
- G. Support: Center support at bottom of 180 degree return.
- H. Drain/Air Release: At bottom of 180 degree return.
- I. For Natural Gas: Approved by the CSA and complying with UL536.
- J. Basis of Design: Metraflex Metraloop. Vee configuration Mason-Mercer VFL.

2.5 FLEXIBLE EXPANSION LOOP (FOR THERMAL AND SEISMIC APPLICATIONS) - COPPER PIPING

- A. Construction: Two flexible Sections of hose and braid, two 90 degree elbows and a 180 degree return designed so piping does not change direction, but maintains course along a single axis. Use Vee Loop where space is limited. System to import no thrust loads to system support anchors or building structure.
- B. Inner Hose: Bronze, close pitch, annular corrugated hose.
- C. Exterior Sleeve: Braided bronze.
- D. Pressure Rating: 125 PSI at 70 degrees F with a 4 to 1 safety factor.
- E. Joint: Sweat ends.
- F. Size: Use pipe sized units.
- G. Support: Center support at bottom of 180 degree return.
- H. Basis of Design: Metraflex Metraloop. Vee configuration Mason-Mercer VCPSB.

END OF SECTION

SECTION 220519 PLUMBING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Pressure Gauges
 - 2. Thermometers
 - 3. Water Hammer Arrestors (Shock Absorbers) - Bellows and Piston Type
 - 4. Trap Primers

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 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

2.1 MANUFACTURERS

- A. Pressure Gauges:
 - 1. Dwyer Instruments, Inc.
 - 2. Moeller Instrument Co., Inc.
 - 3. Omega Engineering, Inc.
 - 4. Trerice
 - 5. Or approved equivalent.
- B. Thermometers:
 - 1. Ashcroft
 - 2. Trerice
 - 3. Weiss
 - 4. Marshalltown
 - 5. Weksler
 - 6. Or approved equivalent.

C. Water Hammer Arrestors (Shock Absorbers), Bellows Type:

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.

D. Trap Primers:

1. Wade
2. Zurn
3. J.R. Smith
4. PPP
5. Or approved equivalent.

2.2 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.

2.3 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.

2.4 WATER HAMMER ARRESTORS (SHOCK ABSORBERS)

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

2.5 TRAP PRIMERS

- A. Trap seal automatic primer valve with integral anti siphon protection. Code approval required.
- B. Electronic trap seal automatic primer valve with integral anti siphon protection tied to DDC system. Coordinate quantity, locations and voltage characteristics for control points and with Section "Controls."
- C. 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 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SUMMARY

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

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

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

1.5 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.

1.6 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

2.1 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. Butterfly Valves:
 - 1. See Valves General above.

F. Swing Check Valves:

1. See Valves General above.

G. 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 - 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 Resistent 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.

H. Pressure Regulating Valve-Domestic Water:

1. Cash Acme
2. Cla-Val
3. Watts
4. Wilkins

5. Or approved equivalent.
- I. 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.

2.2 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.
 2. Butterfly Valves: With extended neck.
- 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.
 - b. Pipe Sizes 4-inches and Larger: Butterfly Valve.
 2. Drain Service: Ball valves.
 3. Strainer Blow-Off: Ball Valve.
 4. Check Valves: Swing.

2.3 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.

2.4 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, brass or stainless steel ball, Teflon seat or brass stem. Apollo 70CLF 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, brass or stainless steel ball, Teflon seat or brass stem. 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.

2.5 BUTTERFLY VALVES

- A. Select lug type valves.
- B. 6-inches and Smaller: 200 PSI, ductile iron body, extended neck, stainless steel stem with stainless steel disc, reinforced resilient EPDM seat, memory stop control, lever handle through 5-inches, size and worm gear operator for 6-inches and larger. Mount stem in horizontal position. Manual lever and lock. MSS SP-58, Type 1.
- C. 8-inches and Larger: 200 PSI, ductile iron body, extended neck stainless steel disc and stem, reinforced resilient EPDM seat, memory stop control, lever handle through 5-inches, size and worm gear operator for 6-inches and larger. Mount stem in horizontal position. Manual lever and lock. MSS SP-67, Type 1.

2.6 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. MSS 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. Gruvlok Series 7800 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.

2.7 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.

2.8 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.

2.9 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 fahrenheit 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.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 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 & Materials

1.2 RELATED SECTIONS

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

1.3 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 manufacturers requirements and Code requirements.
 - 3. Terminology: As defined in MSS SP-90 "Guidelines on Terminology for Pipe Hangers and Supports".
 - 4. Install piping per SMACNA's requirements.

1.4 SUBMITTALS

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

1.5 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. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support, trapeze, equipment hangers/supports, and seismic restraint by a qualified Structural Professional Engineer.
 - a. 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.
 - 3. 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.
 - 4. Support systems to be supplied by a single manufacturer.

1.6 WARRANTY

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

1.7 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 conduit, piping, and ductwork 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 220548.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 220548.

PART 2 PRODUCTS

2.1 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. Rilco Manufacturing Co. Inc.
 - f. Nelson-Olson Inc.
 - g. 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 & Materials:
 - 1. See Miscellaneous Metal & Materials article below.

2.2 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.
- C. 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.
- D. Concrete Inserts:
1. Malleable iron body, hot dipped galvanized finish. Lateral adjustment. MSS Type 18.
- E. Continuous Concrete Insert:
1. Steel construction, minimum 12 gauge. Electrogalvanized finish. Pipe clamps and insert nuts to match.
- F. Beam Clamps:
1. MSS Type 19 and 23, wide throat, with retaining clip.
 2. Universal Side Beam Clamp: MSS Type 20.
- G. 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.
- H. Hangers for Pipe Size 2-inches and Smaller:
1. Adjustable swivel ring hanger, UL listed, Type 6 or Type 10.
- I. Hangers for Pipe Size 2-1/2-inches and Larger:
1. Adjustable clevis type, UL listed, Type 1.
- J. Riser Clamps:
1. Steel, UL listed. MSS Type 8.
- K. Plumbers Tape:
1. Not permitted as pipe hangers or pipe straps.
- L. 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.
- M. 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.

2.3 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.

2.4 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. Building Attachments:
 - 1. Beam Clamps:
 - a. MSS Type 19 and 23, wide throat, with retaining clip.
 - b. Universal Side Beam Clamp: MSS Type 20.
 - 2. Anchor Bolts:
 - a. General: 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.
 - b. 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.
 - c. 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.
 - d. Anchor (Adhesive) Bolts: Consisting of two-part adhesive cartridge and zinc-plated Type A307 steel anchor bolt rod assembly with ASTM A194 nut.
 - 3. Building Attachments:
 - a. Factory fabricated attachments to suit building substructure conditions and in accordance with manufacturer's published product information.
 - b. Select size of building attachments to suit hanger rods.
 - 4. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
 - 5. Grout: ASTM C1107, Grade B, factory mixed and packaged, nonshrink and nonmetallic, dry, hydraulic-cement grout.
 - a. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - b. Properties: Nonstaining, noncorrosive, and non-gaseous.
 - c. Design Mix: 5000-PSI (34.5-MPa), 28-day compressive strength.

2.5 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 galvanized components for items exposed to weather.

2.6 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 ductwork.
- 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 220548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation
 - 2. Seismic - Bracing/Restraint Devices/Systems for Equipment and Piping

1.2 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

1.3 REFERENCES AND STANDARDS

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

1.4 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.
 - 2. Seismic Restraint:
 - a. Shop Drawings: Show compliance with requirements of Quality Assurance article of this Section. Shop Drawings will be stamped by professional structural engineer licensed in state of California.
 - b. Calculations: Submit seismic calculations indicating restraint loadings resulting from design seismic forces. Include anchorage details. Calculations will be certified by professional structural engineer licensed in the state of California.

1.5 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.
2. Seismic Restraint:
- a. Seismic restraint and anchorage of permanent equipment and associated systems listed below to building structure will 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) Housekeeping slabs: provide reinforcement and anchorage to building structure.
 - b. Where required, seismic sway bracing of suspended piping will meet the following:
 - 1) Pipe runs requiring seismic bracing will have a minimum of two traverse braces and one longitudinal brace. A longitudinal (or a 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 runs that pass through seismic separation joints must be restrained within 5-feet of both sides of the separation.
 - 3) Seismic brace assembly spacing will not exceed 40-feet transverse and 80-feet longitudinal.
 - c. Seismic sway bracing of suspended piping will be performed for the following:
 - 1) Piping 2-1/2-inches nominal diameter and larger and trapeze systems where total area of pipe exceeds 3 square inches.
 - d. Seismic restraints may be omitted from suspended piping if the following conditions are satisfied:
 - 1) For piping supported by individual rod hangers 12-inches or less in length from top of pipe to bottom of structural support. Top connections to structure will have swivel joints, eye bolts, or vibration isolation hangers for the entire length of the system run.
 - 2) Lateral motion of the 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, or similar ductile material with ductile connections.
 - e. Seismic restraints, including anchors to building structure, will be designed by registered professional structural engineer licensed in state of California. Design will include:
 - 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 approval number verifying the horizontal and vertical ratings of the 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 will be indicated on Drawings at each brace location. Drawings will bear stamp and signature of registered professional structural engineer who designed layout of braces.

1.6 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

2.1 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.
- B. Seismic - Bracing/Restraint Devices/Systems for Equipment and Piping:
 1. Amber-Booth.
 2. California Dynamics Corporation.
 3. Cooper B-Line, Inc.
 4. Hilti, Inc.
 5. Mason Industries, Inc.
 6. Kinetics Noise Control.
 7. Unistrut.
 8. ISAT, Inc.
 9. Or approved equivalent.

2.2 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 and bonded to 1/4-inch thick rubber isolator pad attached to baseplate underside, mounts with leveling bolts. Mason Type SLFH.
- 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.

2.3 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT AND PIPING

- A. General Requirements for Restraint Components: Rated strengths, features, and applications will 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 will be at least four times the maximum seismic forces to which they will be subjected.
- C. Anchor bolts for attaching to concrete will be seismic-rated, drill-in, and stud-wedge or female-wedge type. Provide anchor bolts suitable for cracked concrete.
- 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 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Plastic Nameplates
 - 2. Tags
 - 3. Plastic Pipe Markers
 - 4. Detectable Underground Tape

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing 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.
 - b. Provide Schedules organized as follows:
 - 1) Equipment Type:
 - (a) Identification:
 - (b) Background:
 - (1) Size:
 - (2) Color:
 - (c) Lettering:
 - (1) Size:
 - (2) Color:
 - c. For renovations or expansions of existing systems, coordinate with Owner and develop valve schedule on existing schedule naming and format.

1.5 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.

1.6 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

2.1 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.
- E. Detectable Underground Tape:
 - 1. Brady Corp.
 - 2. Brimar
 - 3. Champion American
 - 4. Craftmark
 - 5. Seton Identification Products
 - 6. Or approved equivalent.

2.2 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 one-eighth-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.

2.3 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.

2.4 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.

2.5 DETECTABLE UNDERGROUND TAPE

- A. Underground Plastic Pipe Markers: Bright colored continuously printed plastic ribbon tape with aluminum backing, minimum 6-inches wide by 4 mil thick, manufactured for direct burial service. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

END OF SECTION

SECTION 220593

TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

PART 1 GENERAL

1.1 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.

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

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

1.5 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 balance and testing agency which specializes in balancing and testing of plumbing systems, 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 testing, adjusting and balancing.
 - 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 representative and the engineer's representative need not occur simultaneously.
7. Do not perform testing, adjusting, and balancing work until plumbing equipment has been completely installed and is operating continuously as required.
8. Conduct testing and balancing with clean filters in place. Clean strainers prior to performing testing and balancing.
9. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB.
10. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing 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) Testing, adjusting, and balancing 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 Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - b. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
12. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
13. Testing, Adjusting, and Balancing 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.

1.6 WARRANTY

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

1.7 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 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 Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing 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.

1.8 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 testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on piping distribution systems have been satisfactorily completed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 PROJECT CONDITIONS

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

3.2 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 testing, adjusting, and balancing 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 testing, adjusting, and balancing procedures.
- K. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Prepare a testing, adjusting, and balancing 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 testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.

3.4 GENERAL TESTING AND BALANCING PROCEDURES

- A. Perform testing and balancing 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.

3.5 ADJUSTMENT TOLERANCES

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

3.6 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.

3.7 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 testing and balancing 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.

3.8 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 testing and balancing 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 testing, adjusting, and balancing 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 testing, adjusting, and balancing 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 220700 PLUMBING INSULATION

PART 1 GENERAL

1.1 SUMMARY

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

1.2 RELATED SECTIONS

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

1.3 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.

1.4 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.

1.5 QUALITY ASSURANCE

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

1.6 WARRANTY

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

1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of composite insulation construction as installed to be not more than a flame spread of 25, fuel contribution of 50 and smoke development of 50 as tested by ASTM E84 (NFPA 255) method.
- B. Test pipe insulation in accordance with requirements of UL "Pipe and Equipment Coverings".

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. General:
 - 1. Armacell LLC Armaflex
 - 2. Certainteed
 - 3. Johns Manville
 - 4. Knauf
 - 5. Owens-Corning
 - 6. PPG
 - 7. Or approved equivalent.
- B. Type 1, Fiberglass Pipe Insulation:
 - 1. Owens-Corning
 - 2. Johns Manville
 - 3. Or approved equivalent.
- C. Type 2, Flexible Elastomeric Insulation:
 - 1. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. Halstead
 - c. Or approved equivalent.
 - 2. Paint:
 - a. Armacell LLC Armaflex
 - b. Halstead
 - c. Or approved equivalent.
- D. Type 5, Fiberglass Equipment Insulation:
 - 1. Knauf
 - 2. Owens-Corning
 - 3. Johns Manville
 - 4. Or approved equivalent.
- E. 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.
- F. Jacketing:
 - 1. ITW Insulation Systems
 - 2. Or approved equivalent.
- G. Accessories:
 - 1. ITW Insulation Systems

2. Or approved equivalent.
- H. Pipe Fitting Insulation Covers:
1. Zeston Johns Manville
 2. ITW Insulation Systems
 3. Or approved equivalent.

2.2 TYPE 1, FIBERGLASS PIPE INSULATION

- A. Glass Fiber: ASTM C547; rigid molded, noncombustible.
1. Thermal Conductivity Value: $0.27 \text{ BTU} \cdot \text{in} / (\text{hr} \cdot \text{sf} \cdot \text{F})$ at 75 degrees F.
 2. Maximum Service Temperature: 850 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.

2.3 TYPE 2, FLEXIBLE ELASTOMERIC INSULATION

- A. Elastomeric Foam: ASTM C534; flexible, cellular elastomeric, molded or sheet.
1. Thermal Conductivity Value: $0.25 \text{ BTU} \cdot \text{in} / (\text{hr} \cdot \text{sf} \cdot \text{F})$ 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 manufacturers 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.

2.4 TYPE 5, FIBERGLASS EQUIPMENT INSULATION

- A. Flexible Fiberglass Blanket: ASTM C612; flexible.
1. Thermal Conductivity Value: $0.24 \text{ BTU} \cdot \text{in} / (\text{hr} \cdot \text{sf} \cdot \text{F})$ at 75 degrees F.
 2. Maximum Service Temperature: 450 degrees F.

2.5 TYPE 7, ADA ACCESSIBLE LAVATORY/SINK INSULATION KIT

- A. P-traps, trap arms, tail pieces, hot water and cold water insulating guards. Molded closed cell insulation with vinyl cover and nylon fasteners, paintable. Thermal conductivity; $K = 1.17 \text{ (BTU} \cdot \text{in} / (\text{hr} \cdot \text{sf} \cdot \text{F})$ 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.

2.6 JACKETING

- A. 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.

2.7 ACCESSORIES

- A. Equipment Insulation Compounds: Provide adhesives, cement, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- B. 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 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.

2.8 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 220800 COMMISSIONING OF PLUMBING

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. See Division 01, General Requirements for overall objectives and comply with requirements.
 - a. This Section covers the Contractor's responsibilities for commissioning; installer responsible for installation of a particular system or equipment item to be commissioned is responsible for commissioning activities relating to that system or equipment item.
 - b. Plumbing systems to be commissioned will include the following:
 - 1) Sanitary Waste and Vent.
 - 2) Roof and Storm Drainage.
 - 3) Sump/ejector pumps.
 - 4) Domestic water booster pumps.
 - 5) Domestic water heaters.
 - 6) Domestic hot water circulating pumps.
 - 7) Domestic cold water distribution.
 - 8) Domestic hot water distribution.
 - 9) Rainwater harvesting reclaim and piping.
 - 10) Plumbing fixtures.
 - 11) Fuel Oil System Distribution.
 - 12) Plumbing systems/emergency power source integration.
 - 13) Plumbing systems/building automation system integration.
 - c. Pre-Functional Checklist and Functional Test requirements specified in this Section are in addition to, not a substitute for, inspection or testing specified in other Sections.

1.2 RELATED SECTIONS

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

1.3 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. ASHRAE Guideline 0, The Commissioning Process.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Pressure Tests, Flushing Reports, and Startup Reports. Submit for approval of Commissioning Authority.

1.5 QUALITY ASSURANCE

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

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 22 00 00, Plumbing Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Commissioning, inspecting, and testing will not modify terms or time periods of mechanical equipment, systems, and controls warranties including related equipment and system, and adjacent work.
 - 2. Control system warranty period starts from date of Commissioning Agent acceptance.

1.7 COORDINATION

- A. Reference Division 01 specifications for General Commissioning Requirements for requirements pertaining to coordination during the commissioning process.

1.8 PURPOSE

- A. Purpose of commissioning process is to provide Owner assurance that systems have been installed in prescribed manner and will operate within performance guidelines. Commissioning is intended to enhance quality of system startup and aid in orderly transfer of systems to beneficial use by Owner.
- B. Commissioning procedures and results will be observed by Commissioning Authority or Owner's staff. Contractor is expected to verify functional readiness of systems to be tested prior to performing the tests in presence of Owner's witness. A high rate of test failure will indicate that Contractor has not adequately verified readiness of systems.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

- A. Provide standard testing equipment required to perform startup and initial checkout and required functional performance testing; unless otherwise noted such testing equipment will NOT become property of Owner.
- B. Specialized tools, test equipment, and instruments required to execute Start-up, checkout, and testing of equipment are to be of sufficient quality and accuracy to test and/or measure system performance within specified tolerances. A testing laboratory must have calibrated its test equipment within the previous 12 months. Calibration to be NIST traceable. Contractor must calibrate test equipment and instruments according to manufacturer's recommended intervals and whenever the test equipment is dropped or damaged. Calibration tags must be affixed to the test equipment or certificates readily available.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become property of Owner.

PART 3 EXECUTION

3.1 PREPARATION

- A. Cooperate with Commissioning Authority in development of the Pre-Functional Checklists and Functional Test Procedures.
- B. As part of required submittals for contract, within 3 months of award of contract, submit for each piece of equipment and controls, manufacturer's startup and installation procedures as well as controls point-to-point and sequence checkout and provide in check list format.
- C. Furnish additional information requested by the Commissioning Authority.

- D. Prepare a preliminary schedule for Plumbing pipe systems testing, flushing and cleaning, equipment start-up and testing, adjusting, and balancing start and completion for use by the Commissioning Authority; update schedule as appropriate.
- E. Notify Commissioning Authority when pipe system testing, flushing, cleaning, startup of each piece of equipment and testing, adjusting, and balancing will occur; when commissioning activities not yet performed or not yet scheduled will delay construction notify ahead of time and be proactive in seeing that Commissioning Authority has scheduling information needed to efficiently execute commissioning process.
- F. Put equipment and systems into operation and continue operation during each working day of testing, adjusting, and balancing and commissioning, as required.
- G. Provide temperature and pressure taps in accordance with Contract Documents.
- H. Provide a pressure/temperature plug at each water sensor which is an input point to control system.

3.2 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the Commissioning Authority.
- B. Participate in Plumbing systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the Commissioning Authority.
- C. Provide information requested by the Commissioning Authority for final commissioning documentation.
- D. Include requirements for submittal data, operation and maintenance data, and training in each purchase order or sub-contract written.
- E. Prepare preliminary schedule for Plumbing system orientations and inspections, operation and maintenance manual submissions, training sessions, pipe and duct system testing, flushing and cleaning, equipment startup, testing and balancing and task completion for Owner. Distribute preliminary schedule to commissioning team members.
- F. Update schedule as required throughout the construction period.
- G. During the startup and initial checkout process, execute the related portions of the Pre-Functional Checklists for commissioned equipment.
- H. Assist the Commissioning Authority in verification and Functional Performance Tests.
- I. Gather operation and maintenance literature on equipment and assemble in binders as required by the Specifications. Submit to Commissioning Authority (45) days after substantial completion.
- J. Coordinate with the Commissioning Authority to provide (48) hour advance notice so that the witnessing of equipment and system startup and testing can begin.
- K. Notify the Commissioning Authority a minimum of (1) week in advance of the time for the start of the balancing work.
- L. Participate in, and schedule vendors and contractors to participate in the training sessions.
- M. Provide written notification to the CM/GC and Commissioning Authority that the following work has been completed in accordance with the Contract Documents, and that the equipment, systems, and sub-system are operating as required.
 - 1. Plumbing equipment including domestic water heaters, pumps, plumbing fixtures, and other equipment furnished under this Division.
 - 2. Gas piping, sanitary waste and vent piping, storm drainage piping, sump pumps and automatic sprinkler system.
- N. Provide training of the Owner's operating staff using expert qualified personnel, as specified.
- O. Reference Division 01 specifications for General Commissioning Requirements, for additional contractor responsibilities.

3.3 OWNER'S RESPONSIBILITIES

- A. Reference Division 01 specifications for General Commissioning Requirements for Owners responsibilities.

3.4 DESIGN PROFESSIONAL'S RESPONSIBILITIES

- A. Reference Division 01 specifications for General Commissioning Requirements for the Architect, Mechanical, Electrical, and Plumbing Engineers responsibilities.

3.5 COMMISSIONING AUTHORITY'S (COMMISSIONING AUTHORITY) RESPONSIBILITIES

- A. Reference Division 01 specifications for General Commissioning Requirements for the Commissioning Authority's responsibilities.

3.6 TESTING PREPARATION

- A. Certify, in writing, to the Commissioning Authority that plumbing instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pre-test setpoints have been recorded.
- B. Certify, in writing, that discrepancies discovered during the test and balance process have been resolved and that testing, adjusting, and balancing is completed.
- C. Set systems, subsystems, and equipment into operating mode to be tested (e.g. normal auto position, normal manual position, unoccupied mode, emergency power and alarm conditions).
- D. Inspect and verify the position of each device and interlock identified on checklists.
- E. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode operation.

3.7 TAB COORDINATION

- A. TAB: Testing, adjusting, and balancing of Plumbing.
- B. Coordinate commissioning schedule with TAB schedule.
- C. Review the TAB plan to determine capabilities of the control system toward completing TAB.
- D. Provide necessary unique instruments and instruct TAB technicians in their use; such as handheld control system interface, etc.
- E. Have required Pre-Functional Checklists, calibrations, startup and component Functional Tests of the system completed and approved by Commissioning Authority prior to starting TAB.
- F. Provide a qualified control system technician to operate controls to assist TAB technicians or provide sufficient training for TAB technicians to operate system without assistance.

3.8 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of Commissioning Authority.
- B. Scope of Plumbing testing to include entire Plumbing installation. Testing to include measuring capacities and effectiveness of operational and control functions.
- C. Test operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automations system controllers and sensors.
- D. The Commissioning Authority along with the Plumbing contractor, balancing subcontractor to prepare detailed testing plans, procedures, and checklists for Plumbing systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever applicable.

- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the Commissioning Authority and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.
- G. The Commissioning Authority may direct that setpoints be altered when simulating conditions is not practical.
- H. The Commissioning Authority may direct that sensor values be altered with a signal generator when design or simulating conditions and altering setpoints are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the Plumbing system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

3.9 PLUMBING SYSTEMS, SUBSYSTEMS AND EQUIPMENT TESTING PROCEDURES

- A. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment: Test requirements are specified in Division 22, Plumbing piping Sections. Plumbing Contractor to prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the Commissioning Authority. Plan should include the following.
 - 1. Sequence of testing procedures for each Section of pipe to be tested, identified by pipe zone or sector identifications marker. Markers to be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test Section. Drawings keyed to pipe zones or sectors to be formatted to allow each Section to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing velocity.
- B. Plumbing Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, fuel gas, sanitary waste and vent piping, storm drainage piping, sprinkler and domestic water distribution systems.
- C. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.
- D. Functional Performance Tests: Tests will be fully documented with test procedures, expected results for each procedure, and documented in either pass or fail. Tests are written by the Commissioning Authority and performed by the Contractor. The Commissioning Authority documents the results of the test.

3.10 DEFICIENCIES / NON-CONFORMANCE AND COST OF RETESTING

- A. The Commissioning Authority documents the results of the tests. Corrections of minor deficiencies identified are made during the tests at the discretion of the Commissioning Authority. The Commissioning Authority documents the testing results on the Functional Performance Testing document. Deficiencies or non-conformance issues are noted and reported to the GC and Owner via the Master Cx Issues/Resolutions Log. The Contractor will then correct deficiencies, notify the Commissioning Authority of the correction, and then schedule retesting of the issue with the GC and Commissioning Authority. For areas in dispute of the issue between the Commissioning Authority and Contractor to go directly to the A/E. A/E to provide direction of the design intent and expected result to clear up the dispute.
- B. If the Plumbing contractor fails to demonstrate proper sequence of operation in any of the second round of Functional Performance Tests, the Commissioning Authority's costs for witnessing further demonstration of that test procedure may be assigned to the Plumbing contractor by the Owner as a deduct to their contracted price. The Plumbing contractor will not be responsible for costs related to failure due to design or other factors beyond their control, though it is expected to call any design concerns (and other factors beyond their control that might cause failure) to the attention of the GC and Commissioning Authority.

- C. Reference Division 01 specifications for General Commissioning Requirements for additional contractor responsibilities

3.11 OPERATION AND MAINTENANCE MANUALS

- A. See Division 01, General Requirements for additional requirements.
- B. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- C. Commissioning Authority will add commissioning records to manuals after submission to Owner.

3.12 DEMONSTRATION AND TRAINING

- A. See Division 01, General Requirements for additional requirements.
- B. Demonstrate operation and maintenance of Plumbing systems to Owner's personnel; if during any demonstration, system fails to perform in accordance with information included in O&M manual, stop demonstration, repair or adjust, and repeat demonstration. Demonstrations may be combined with training sessions if appropriate.
- C. These demonstrations are in addition to, and not a substitute for, Pre-Functional Checklists and demonstrations to Commissioning Authority during Functional Testing.
- D. Training:
 - 1. Submit a written training plan to the Owner and Architect/Engineer for review and approval. Contractor's training plan to cover the following elements:
 - a. Equipment included in training.
 - 1) Intended audience.
 - 2) Location of training.
 - 3) Objectives.
 - b. Subjects covered.
 - c. Duration of training on each subject.
 - d. Instructor for each subject.
 - e. Methods (classroom lecture, video, Site walk-through, actual operational demonstrations, written hand outs, etc.).
 - f. Instructors and qualifications.
 - 2. Contractor is to have the following training responsibilities:
 - a. Provide a training plan ten calendar days prior to the scheduled training, in accordance with Division 01, General Requirements.
 - b. Provide Owner personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned mechanical equipment or system.
 - c. Training to start with classroom sessions, if necessary, followed by hands-on training on each piece of equipment, which will illustrate the various modes of operation, including Start-up, shutdown, fire/smoke alarm, power failure, etc.
 - d. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
 - e. The appropriate trade or manufacturer's representative will provide the instructions on each major piece of equipment. This representative may be the Start-up technician for the piece of equipment, the installing contractor, or the manufacturer's representative. Practical building operating expertise, as well as in-depth knowledge of modes of operation of the specific piece of equipment, is required. More than one party may be required to execute the training.
- E. Provide the services of manufacturer representatives to assist instructors where necessary.

END OF SECTION

SECTION 221000 PLUMBING PIPING

PART 1 GENERAL

1.1 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. Flanges, Unions, and Couplings
 - 9. Piping Specialties
 - 10. Cleanouts

1.2 RELATED SECTIONS

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

1.3 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. Steel pipe to conform to ASTM and ANSI Standards as specified in this Section.
 - 3. Copper piping to conform to ASTM B88, B306 and B208 and the standards of Copper Development Association (CDA), and American Welding Society, (AWS).
 - 4. Cast Iron Piping to conform to standards of ASTM A-74, CISPI 301 and FM 1680.
 - 5. Manufacturer's Standards Society (MSS) for valving and support reference standard.
 - 6. American Waters Association (AWWA) for Valving Assembly Standards.
 - 7. American Society of Sanitation Engineers (ASSE) for Valving Standards.
 - 8. American National Standards Institute (ANSI) for Piping Standards.
 - 9. NFPA Standard 51B - "Fire Prevention in Use of Cutting and Welding Processes".
 - 10. Crosslinked polyethylene (PEX) pipe conforming to ASTM F876, F877 and CSA B1375, or DIN 16892 and 16893.

1.4 SUBMITTALS

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

1.5 QUALITY ASSURANCE

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

1.6 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

2.1 MANUFACTURERS

- A. See component manufacturers listed in individual articles below.
- B. Uponor
- C. Cerro
- D. Dodge Phelps
- E. Tyler
- F. ADS
- G. Charlotte
- H. Elkhart
- I. Enfield
- J. Spears
- K. Nibco
- L. Orion
- M. American-USA
- N. or approved equivalent.
- O. Cleanouts:
 - 1. J.R. Smith
 - 2. Zurn
 - 3. Wade
 - 4. Watts
 - 5. Or approved equivalent.
- P. Firestopping Penetrations in Fire Rated Wall Floor Assemblies:
 - 1. Hilti
 - 2. Proset
 - 3. Or approved equivalent.

2.2 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: Each item to be furnished with legible markings indicating: name brand and manufacturer, manufacturing process, heat number and markings as required per ASTM and UL/FM Standards.

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

- A. Cast Iron Pipe: ASTM A 74 extra heavy weight weight hub and spigot.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot ASTM C564 neoprene gaskets and conform to ASTM C1563.
- B. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540/HUSKYSD4000, Clamp-All Hi-Torq 125 coupling. Husky SD 4000.
- C. Copper Tube: ASTM B 306, DWV
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, ASTM B-828 and NSF 61, Annex G alloy Sn50 solder.
 - 3. Flux: ASTM B813-91, water soluble.

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

- A. Cast Iron Pipe: ASTM A 74 service weight weight hub and spigot.
 - 1. Fittings: Cast iron.
 - 2. Joints: Hub-and-spigot ASTM C564 neoprene gaskets and conform to ASTM C1563.
- B. Cast Iron Pipe: ASTM A888/CISPI 301 hubless.
 - 1. Fittings: Cast iron.
 - 2. Coupling Assembly:
 - a. Heavy Duty: ASTM C1540/HUSKYSD4000, Clamp-All Hi-Torq 125 coupling. Husky SD 4000.
- C. Copper Tube: ASTM B 306, DWV, for in-wall waste and vent only.
 - 1. Fittings: ASME B16.29, wrought copper.
 - 2. Joints: ASTM B32, alloy Sn50 solder.

2.5 PUMP WASTE PRESSURE PIPING (PUMPED DISCHARGE)

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

2.6 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.

2.7 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.

2.8 CONDENSATE PIPING

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

2.9 PRIMER PIPING

- A. Above Ground: Type L hard-drawn copper tubing with wrought sweat fittings and soldered joints.
- B. Belowground: Type L soft annealed copper tubing with wrought sweat fittings and brazed joints.

2.10 FLANGES, UNIONS, AND COUPLINGS

- A. Unions for Pipe Sizes 3-inches and Under:
 1. Ferrous Pipe: Class 150 malleable iron threaded unions.
 2. Copper Tube and Pipe: Class 150 bronze unions with soldered joints.
- B. Flanges for Pipe Size Over 1-Inch:
 1. Ferrous Pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
 2. Copper Tube and Pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.
- C. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

2.11 PIPING SPECIALTIES

- A. Pipe Escutcheons:
 1. Provide pipe escutcheons as specified with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas.
 2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged.
 3. Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged.
- B. Low Pressure Y-Type Pipeline Strainers:
 1. Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 percent of the working pressure of piping system with Type 304 stainless steel screens made with 8mm perforations at 233 perforations per square millimeter.
 2. Threaded Ends, 2-inch and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with plug.
 3. Flanged Ends, 2-1/2-inch and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with hose bibb.
- C. Air Vent with Valves:

1. Install automatic air vents in all closed and open-loop water systems at high points and at any other point necessary to free system of air. A shut-off valve to be provided in riser to each automatic vent valve to facilitate servicing. Manual type vent may be used in lieu of automatic type, where specifically shown on the Drawings.
 2. Manufacturer: Hoffman #79.
- D. Dielectric Waterways:
1. Provide standard products recommended by manufacturers in service indicated, which effectively isolate ferrous from non-ferrous piping (eliminating electrical conductance) to prevent galvanic action and stop corrosion.
 2. Provide dielectric waterways or brass nipple fitting for transitions between dissimilar metal piping.
- E. Unions:
1. Unions to comply with the following schedule:
 - a. Black Steel, 2-inch and smaller: 150 PSI screwed malleable iron, ground joint, brass to iron seat.
 - b. Black Steel, 2-1/2-inch and larger: 150 PSI cast iron screwed flanged, flat faced, full faced gasket.
 - c. Soldered Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast bronzed or copper, ground joint, non-ferrous seat with soldered ends.
 - d. Screwed Copper or Brass Pipe, 2-inch and smaller: 150 PSI cast brass, ground joint, brass to brass seat, threaded ends.
 - e. Flanged Copper or Brass Pipe, 2-1/2-inch and larger: Two 150 PSI cast bronze flanges.
 - f. Manufacturer: EPCO, Mueller or Stanley G. Flagg or Watts or approved equivalent.
- F. Flexible Piping Connectors - Expansion Loops or Seismic Joints:
1. Provide flexible expansion loops of size and material noted on Drawings. Flexible loops to be designed to impart no thrust loads on the anchors. The loop consists of two flexible Sections of hose and braid, two 90 degree elbows, and a 180 degree return. Loops to be installed in a neutral, precompressed, or preextended condition as required for the application. Loops installed hanging down to have a drain plug. Loops installed straight up may be fitted with an automatic air release valve to purge air from the high point of the loop. Loops installed in any position other than hanging down must have the 180 degree return supported.
 2. Copper Pipe: Copper fittings, bronze hose and braid sweat solder ends, Metraloop Series MLS 8000.
 3. Steel Pipe: Schedule 40 carbon steel fittings, stainless steel hose and braid,
 4. Threaded Ends: Metraloop Series MLT 80000
 5. Flanged Ends: Metraloop Series MLF 80000
 6. Welded Ends: Metraloop Series MLW 80000
 7. Grooved Ends: Metraloop Series MLG 80000
 8. Gas Lines, CSA Approved: Metraloop - Gas MLT or MLF Series.
 9. Vertical and horizontal straight run hot water and domestic hot water recirculation piping exceeding 1,000-feet to be provided with expansion joints by Mason, Flexionics or Shur Fit. Installation to be per manufacturer's installation directions.

2.12 CLEANOUTS

- A. General: 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 vandalproof screws.

2. Carpeted Floor Cleanout: J. R. Smith 4020-X with carpet clamping frame 4023-Y, round heavy-duty nickel bronze top, taper thread, bronze plug, carpet clamping device and vandalproof screws.
3. Concrete Floor Cleanout (General): J. R. Smith 4020 with round heavy-duty nickel bronze top, taper thread and bronze plug with vandalproof screws.
4. Parking, Drives and Concrete Floor Cleanouts (Heavy Load): J. R. Smith 4100 with round heavy-duty nickel bronze top, taper thread and bronze plug with vandalproof 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 221416

RAINWATER AND GREYWATER HARVEST AND TREATMENT SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Greywater and Treated Water Holding Tank
 - 2. Duplex Submersible Sump Pump
 - 3. Skidmounted Greywater Treatment System
 - 4. Duplex Variable Speed Booster Pump

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 22 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. ANSI/AWWA D120-09: Thermosetting Fiberglass-Reinforced Plastic Tanks.
 - 2. UL-1316 NSF-350 item #3.

1.4 SUBMITTALS

- A. Submittals as required by Section 22 00 00 and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Provide P&ID (process and instrumentation diagram) showing process flow; all equipment; all piping(excluding piping to individual plumbing fixtures); all control points; and control sequence.
 - 2. Construction drawing showing all equipment and piping indicating the size, material and connection type of all piping required to be done in the field.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 22 00 00 and Division 01, General Requirements.
- B. In addition, meet the following:
 - 1. Complete working system designed to meet all greywater treatment system design criteria and standards listed in this document and construction drawings to be designed and supplied by single manufacturer.
 - 2. Greywater from showers and sinks will be collected and conveyed by gravity to a single below grade sump with approximately 10,000 gallons capacity. Sump will also collect backwash from the pool system in quantities of approximately 7,500 gallons every week
 - 3. Greywater will be continuously processed to prevent raw greywater from standing the sump for longer than a few hours. Raw greywater left sitting overnight will be pumped to the municipal sewer system.
 - 4. An overflow from the sump will be provided and connected to the municipal sewer.
 - 5. A treatment system achieving NSF-350 water quality will be provided. Treatment system will be capable of treating the entire collection capacity within 8 hours. See water quality standards below:

	<u>NSF 350 STANDARD</u>	
	MAX	AVG
Turbidity	5	2
TSS	30	10
CBOD	25	10
E. Coli	200	2.2
Odor	Non Offensive	
pH	6.0 - 9.0	

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 26 00 00 and Division 01, General Requirements.
- B. In addition, provide:
 1. Provide 2-year warranty on all parts and equipment included as part of the Skidmounted Greywater Treatment System.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Greywater and Treated Water Holding Tank
 1. Xerxes
 2. Containment Solutions
 3. Or approved equivalent.
- B. Duplex Submersible Sump Pump
 1. Liberty Pumps
 2. Weil Pumps
 3. Zoeller Pumps
 4. Or approved equivalent.
- C. Skidmounted Greywater Treatment System
 1. Water Harvesting Solutions
 2. Burt Process Equipment, Inc
 3. Or approved equivalent.
- D. Duplex Variable Speed Booster Pump
 1. Bell and Gossett
 2. Tigerflow
 3. Syncroflo
 4. Or approved equivalent.

2.2 GREYWATER AND TREATED WATER HOLDING TANKS

- A. Tank will be constructed of a laminate consisting of resin and glass fiber reinforcement only. No sand/ silica fillers or resin extenders shall be used. Tank will be reinforced with integral structural ribs. All internal mounting hardware will be rustproof.
- B. Tank will be designed:
 1. To withstand a 5-psig air pressure test with a 5:1 safety factor.
 2. To withstand surface H-20 and HS-20 axle loads when properly installed to manufacturer's installation guidelines.

3. For 7 feet of overburden over the top of the tank, the hole fully flooded, and safety factor of 5:1 against general buckling.
 4. With capacities and dimensions per drawings.
- C. Tank manufacturer will be recognized by Underwriters Laboratories as a manufacturer of tanks listed to the UL-1316 standard.
- D. Tank will meet requirements of ANSI/AWWA D120-09.
- E. Accessories:
1. Access openings will have a diameter of 24 inches or 30 inches in diameter complete with riser, lid and necessary hardware and will be located per drawings.
 2. Tank will be equipped with factory with factory-installed fittings or pipe stubs per drawings.
 3. Access risers will be PVC or FRP as supplied by tank manufacturer and will be 24 inches or 30 inches in diameter.

2.3 DUPLEX SUBMERSIBLE SUMP PUMP

- A. System: Grey Water.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Pump casing be one piece cast iron constructed with tripod support legs that provide an even distribution of weight.
- D. Mating surfaces between motor end bell, motor shell and seal chamber sealed by means of Section quad rings. Designs using conventional circulate 'O' rings or rectangular cross sectional gaskets are not considered equal.
- E. Pump motor vertical, NEMA-6 and of an air filled, hermetically sealed design for premium efficiency. Oil filled shell not considered equal.
- F. Motor end bell cast iron, design as terminal box and separated from motor shell by combination bearings support and inspection plate.
- G. Motor housed within water tight, heavy duty cast iron with integral extended cooling fins. Motor have Class 'F' insulation and permanently lubricated, double sealed ball bearings having minimum life of 17,500 hours. Motors using sleeve type bearings not considered equal.
- H. Motor shaft be 300 series stainless steel with keyway for positive positioning of impeller. Motors using carbon steel shafts or stainless stub shafts not be considered equal.
- I. Impeller be multi-vane design, constructed of bronze, accurately machined and dynamically balanced to job site conditions. Impeller will not require use of wearing rings to insure proper operation and be capable of passing 4-inch minimum solids.
- J. Double mechanical seal system be furnished and housed in machined cast iron seal chamber filled with clean dielectric oil, providing constant lubrication. Lower seal surfaces be of solid silicon carbide to provide longer life. Carbon ceramic, tungsten carbide or systems that allow lower seal surfaces to come in contact with pumped media, not be considered equal.
- K. Each pump be tested and computer generated report will be kept in file and made available upon request. Reported test data consisted of six duty point of various heads and capacities, one of which will be design point and includes actual efficiencies and horsepower requirements.
- L. Furnish remote packaged factory pre-wired duplex pump controller with following:
1. NEMA 1 double door dead front steel lockable enclosure.
 2. Magnetic starter with overload reset through cover, each pump.
 3. Fused disconnect switch with handle through cover, each pump.
 4. Automatic alternator, separately fused with lead/lag/alternating capacity.
 5. Overload reset buttons, each pump.

6. Running lights, each pump.
7. H-O-A switches, each pump.
8. Control circuit transformer for 120V operation for each pump.
9. Output connections for hi-water annunciation.
10. Alarm silencing switch.
11. Alarm light with flasher.
12. Numbered and wired terminal strip.
13. Single point electrical connection.
14. Wiring between control panel and pump provided under Division 22, Plumbing

M. Control Switches:

1. Furnish and install mercury float switches complete with galvanized rod and wall support bracket. Each pump control switch will consist of 2 c normally open mercury switches, encapsulated in epoxy resin. Float casing will be polypropylene. Switch cable will be type STO PVC jacket 4 #18 conductor. 41 strand, 600 volt insulation. Cable will be secured to support rod with polypropylene composition clamp with stainless steel bolts. Switches used for high water alarm service will be of same construction as pump switches, except that 2 conductor cables will be furnished. Switch housing will be color coded to distinguish between pump and alarm switches.

N. Operation of Pumps:

1. See Drawings for switch elevation settings.
2. Switch 1 turns lead pump off at 6-inches above bottom of vault.

2.4 SKIDMOUNTED GREYWATER TREATMENT SYSTEM

- A. Provide complete factory constructed and tested system designed to process 30 gallons per minute in batches of 1,000 gallons.
- B. Settling tank will be 1,000 gallon translucent; high density polyethylene; 45 degree canonical bottom tank complete with tank stand and drain capable of emptying entire tank.
- C. Transfer pump of type capable of providing pressure and flow needed through treatment system.
- D. Self-cleaning disc filter capable of removing particles sized 80 microns and larger at treatment design flow.
- E. Self-cleaning multi-media filter capable of removing particles sized 10 microns and larger at treatment design flow.
- F. Cartridge type carbon filter capable of removing particles sized 1 micron and larger at treatment design flow.
- G. Chlorination system designed to create liquid chlorine from dry hypochlorite briquettes.
 1. Provide injection points:
 - a. Between settling tank and transfer pump.
 - b. At treated water holding tank.
 2. Provide chlorine monitoring point in treated water holding tank to maintain residual chlorine level at 0.5 PPM.
- H. Cartridge type carbon filter capable of removing particles sized 1 micron and larger. Filter will be separate from skidmounted system. Filter will remove residual chlorine from treated water prior to being supplied to irrigation system.
- I. Control system will automatically manage all system functions including water treatment system and the addition of municipal water as needed to treated water holding tank. Control system will be full compatible with the building automation system via Modbus or BACNET. Information and system alerts and alarms will be presented via a color touch screen on the control panel and also via network capable to the building automation system. Control system will be capable of being

viewed and controlled remotely throughout the building via a web browser connected to the building's network. Control system will monitor:

1. The amount of water available in each holding tank.
2. How much water has been captured reuse.
3. The amount of municipal water demanded by the system.

2.5 DUPLEX VARIABLE SPEED BOOSTER PUMP - SUBMERSIBLE RECLAIMED WATER BOOSTER PUMP SYSTEM WITH VARIABLE SPEED DRIVE

- A. System: Reclaimed Water.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Furnish and install prefabricated water pressure booster system. System capable of automatically providing constant system pressure.
- D. Pressure for the booster pump system shall be set at 35 PSI - 4 feet above top of highest roof level.
- E. System factory assembled, wired, electrically tested, hydrostatic pressure tested and shipped ready for field piping connection and wiring. Field startup by manufacturer is required for final acceptance.
- F. Factory Test Certification: Factory certifies in writing that water pressure booster system and its component parts have undergone complete electric and hydraulic test prior to shipment. Test includes system operating flow test from zero to 100 percent design flow rate under specified suction and net system pressure conditions. Certification includes copies of test data as recorded by X-Y plotter. System test may be witnessed by Owner by reporting intent to do so to factory.
- G. Pressure gauges supplied on suction and discharge manifold headers and provided with stainless steel cases, glycerin filled, and rated for plus or minus 1 percent accuracy. Gauges selected for operation at mid-scale.
- H. Each pump fitted with isolation valves and union connections or flanges to facilitate future service requirements. Each pump furnished with silent check valve with bronze trim.
- I. Common pump discharge header includes thermally activated purge valve built into header system for booster pumps to allow water to be purged to remote drain in event of system control failure.
- J. Single point disconnect panel skid mounted and factory wired. Factory wiring includes variable frequency drive wiring, motor wiring, differential pressure switch wiring and low suction pressure switch wiring. Pressure transducer shipped loose for field installation at high point in system as standard for optimal performance.
- K. Pump logic controller capable of receiving up to two discrete analog inputs from transmitters indicated on Drawings. It will then select analog signal that has deviated greatest amount from its setpoint. This selected signal will be used as command feedback input for hydraulic stabilization function to minimize hunting. Each input signal capable of maintaining different set point value. Controller capable of controlling up to three pumps in parallel. Scan and compare rate that selects command setpoint and process variable signal continuous and automatically set for optimum operation. Each sensor scanned every 2 milliseconds.
- L. Controller have fused door interlock disconnect, local-off-remote switch, motor overload protection, diagnostic display, manual and automatic alternation, auto start of lag pump on lead failure and accept pump differential pressure switch signals for pump fail notification.
- M. Controller capable of performing the following pressure booster functions:
 1. Low suction pressure cut-out to protect pumps against operating with insufficient suction pressure. This function resets automatically.
 2. High system pressure cut-out to protect piping system against high pressure conditions. This function requires manual reset.

3. No flow shut down to turn the pumps off automatically when system demand is low enough to be supplied by hydropneumatic tank. No flow shutdown requires external flow meters, flow switches, nor pressure switches to determine when no flow condition exists.
- N. The following hardwire communication features provided to BAS:
1. Remote system start/stop non-powered digital input.
 2. Failure of any system component. Output closes to indicate alarm condition.
 3. One 4-20 mA output with selectable output of:
 - a. Frequency
 - b. Process Variable
 - c. Output Current
 - d. Output Power
- O. Entire booster system, including piping, wiring, and controls, UL listed.
- P. Provide remote hydropneumatic tank for reclaimed water system and included as part of booster pump system.
- Q. Components pre-piped, wired, and tested prior to shipment.
- R. Field plumbing connections required will be system suction and discharge headers, temp probe, drain line, piping of hydropneumatic pressure tank with union ball valve, pressure gauge and drain provided.
- S. Field electrical connections required will be input power supply to the control panel and remote pressure transducer control wiring.
- T. Coordinate location of unit and electrical characteristics with Division 26, Electrical work.
- U. Manufacturer's representative provides system check and start-up service for the system.
- V. Acceptable manufacturers: Bell and Gossett, Grundfos, Paco, or Syncro Flo.

END OF SECTION

SECTION 223000 PLUMBING EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Electric Domestic Water Heating System
 - 2. Commercial Domestic Water Storage Tank
 - 3. Domestic Expansion Tanks Non-ASME
 - 4. Domestic Circulation Pump
 - 5. Duplex Sump Pump
 - 6. Duplex Sewage Ejector Pump
 - 7. Packaged Domestic Booster Pump System with Variable Speed Drive
 - 8. Hydro-Pneumatic Tank for Booster Pump System
 - 9. Exterior Grease Interceptor - Large Capacity
 - 10. Lint Trap - Laundry

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 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.

1.5 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.

1.6 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

2.1 MANUFACTURERS

- A. Electric Domestic Water Heating System:
 - 1. Hubbell Series SH
 - 2. Adamson
 - 3. Bock
 - 4. A.O. Smith
 - 5. Or approved equivalent.
- B. Commercial Domestic Water Storage Tank:
 - 1. Cemline "Stonesteel"
 - 2. Hanson
 - 3. Niles
 - 4. Reco USA
 - 5. Or approved equivalent.
- C. Domestic Expansion Tanks Non-ASME:
 - 1. Bell and Gossett Series PT
 - 2. American Wheatly
 - 3. Amtrol
 - 4. Armstrong
 - 5. Watts
 - 6. Or approved equivalent.
- D. Domestic Circulation Pumps:
 - 1. Bell and Gossett Series
 - 2. Armstrong
 - 3. Grundfos
 - 4. Paco
 - 5. Taco
 - 6. Or approved equivalent.
- E. Duplex Sewage Ejector Pump - Air Filled:
 - 1. Acceptable Pump Manufacturer:
 - a. Weil Model
 - b. Goulds
 - c. Chicago
 - d. Hydromatic
 - e. Liberty
 - f. Zoeller
 - g. Or approved equivalent.
 - 2. Remote Controller and Control Switches:
 - a. Weil
 - b. Or approved equivalent.
 - 3. Acceptable Basin Manufacturer:
 - a. LFM
 - b. Canwest
 - c. Jackel
 - d. AK
 - e. Topp
 - f. Or approved equivalent.

F. Packaged Domestic Booster Pump System with Variable Speed Drive:

1. FlowTherm Systems.
2. EnviroSep
3. Federal Pump
4. Grundfos
5. QuantumFlo
6. Paco
7. Peerless
8. Precision
9. Syncro Flo
10. Or approved equivalent.

G. Hydro-Pneumatic Tank for Booster Pump System:

1. Bell and Gossett
2. Amtrol
3. Armstrong
4. American Wheatley
5. Hanson
6. Or approved equivalent.

H. Exterior Grease Interceptor - Large Capacity:

1. Pre-fabricated Concrete Unit:
 - a. Jensen
 - b. Utility Vault
 - c. Wieser
 - d. Wilkenson Precast
 - e. Lar-Ken
 - f. Front Range
 - g. Shope
 - h. Old Castle
 - i. Nottingham
 - j. Teichert
 - k. Or approved equivalent.

I. Lint Trap - Laundry:

1. Cover: Neenah R4810, Type A
2. Drain: Zurn Z645-AR-1C
3. Or approved equivalent.

2.2 GENERAL

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

2.3 ELECTRIC DOMESTIC WATER HEATING SYSTEM

- A. System: Domestic Hot Water
- B. Pressure vessel Section, including electrical control panel, mounted on structural supports and be suitably insulated, jacketed, painted, and provided with lifting lugs. Entire unit is to be packaged ready for plumbing and electrical service connections and bear UL listing mark certifying entire water heater.
- C. Pressure vessel welded construction and ASME Code Section IV stamped for working pressure of 150 PSI. Storage vessel carbon steel and lined with seamless Hydrastone cement applied to minimum thickness of 5/8-inch on 100 percent of interior tank surfaces.

- D. Pressure vessel is to be completely covered with 2-inch thick "E" type energy conservation fiberglass blanket insulation and enclosed in heavy gauge galvanized steel metal jacket finished in gray hammertone enamel.
- E. Vessel protected by an ASME approved automatic reseating combination temperature and pressure relief valve set at tank working pressure and 210 degrees F.
- F. Heater designed to operate with fused low voltage transformer providing 120 volt to operating controls. Immersion heating element(s) high quality copper sheathed Incoloy Type 304 stainless steel Incoloy Type 316 stainless steel and sized to obtain rated recovery. Each element circuit is to be independently operated through definite purpose magnetic contactor having resistive load rating equal to or exceeding ampere rating of that particular circuit and be protected by individual power fuses rated at approximately 125 percent of ampacity of circuit. Multiple circuit elements be provided with master terminal block for connecting of incoming power feeds Built-in non-fused On/Off disconnect switch. Built-in circuit breaker with On/Off handle. Safety door interlock switch interrupts power to control circuit when control panel door is opened. Control thermostat immersion type and be consistent with recovery rate of heating element as to number of steps required. Hi-limit control with manual reset button be factory installed to disconnect ungrounded conductors to heating element(s) in event of an over-temperature condition in storage Section.
- G. Water heater manufacturer warranties electrical components against defects in workmanship and material for period of one year from date of start-up, and pressure vessel for full 5 years non pro-rated from date of start-up, provided that unit is started within three months of date of shipment and installed and operated within scope of tank design and operating capability. Each water heater shipped with complete set of installation and operating instructions including spare parts list and approved drawing.

2.4 COMMERCIAL DOMESTIC WATER STORAGE TANK

- A. System: Domestic Hot Water
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Domestic Water Storage Tank: Provide following:
 - 1. One ASME stamped vertically mounted storage tank.
 - 2. Tank Lining: Cement or Glass.
 - 3. ASME Code Working Pressure: 125 PSI.
 - 4. 11-inches by 15-inches entry manhole.
 - 5. Provide tank tapings for Thermometer, Aquastat sensor, tank drain, relief valve, x" hot water supply and return lines to plate and frame exchangers heat exchangers from mechanical boilers, hot water supply, cold water supply and domestic re-circulating line.
 - 6. Di-election union or water ways on connections to tank.
 - 7. Console with thermometer and water pressure gauge.
 - 8. Drain Valve.
 - 9. 2-inch thick minimum factory or field installed fiberglass insulation, steel jacket and painted.

2.5 DOMESTIC EXPANSION TANKS NON-ASME

- A. Welded steel, constructed, tested and stamped in accordance with IAPMO Standards for working pressure of 125 PSI. Support floor mounted tanks with steel legs or base. Provide single flexible diaphragm securely sealed into tank to separate air charge from system water, to maintain design expansion capacity. Provide pressure gauge and air-charging fitting, and drain fitting. Diaphragm: Removable and replaceable in line.

2.6 DOMESTIC CIRCULATION PUMPS

- A. System: Domestic water.

- B. Provide in-line factory tested pumps, cleaned, and painted with enamel prior to shipment. Pumps be rated for domestic water. Provide pumps of same type by same manufacturer.
- C. Type: Horizontal, oil-lubricated, designed for 150 PSI working pressure, 225F continuous water temperature.
- D. Body: Bronze construction.
- E. Shaft: Stainless steel, ground and polished, integral thrust collar.
- F. Bearings: Two horizontal sleeve sealed steel bearings permanently lubricated designed to circulate oil.
- G. Seal: Mechanical, with carbon seal face rotating against ceramic seat.
- H. Face plate: Stainless steel.
- I. Motor: Nonoverloading at any point on pump curve, open, drip-proof, sleeve bearings, quiet operating, rubber mounted construction, built-in thermal overload protection.
- J. Elastomers: EPDM.
- K. Provide Honeywell 115 volt immersion aquastat set at 115 degrees F.
- L. Option. Pump maybe operated from Building Automation System. Coordinate installation of additional devices with controls contractor.

2.7 DUPLEX SUMP PUMP

- A. System: Storm Drain
- B. Entire unit is to be delivered complete with operating controls and require only plumbing, gas and electrical service connections.
- C. Furnish and install where shown on Drawings, one duplex dewatering pump system to feed water feature.
- D. Pump casing be one piece cast iron constructed with tripod support legs that provide an even distribution of weight.
- E. Mating surfaces between motor end bell, motor shell and seal chamber sealed by means of Section quad rings. Designs using conventional circulate 'O' rings or rectangular cross Sectional gaskets are not considered equal.
- F. Pump motor vertical, NEMA-6 and of an air filled, hermetically sealed design for premium efficiency. Oil filled shell not considered equal.
- G. Motor end bell cast iron, design as terminal box and separated from motor shell by combination bearings support and inspection plate.
- H. Motor housed within water tight, heavy duty cast iron with integral extended cooling fins. Motor have Class 'F' insulation and permanently lubricated, double sealed ball bearings having minimum life of 17,500 hours. Motors using sleeve type bearings not considered equal.
- I. Motor shaft be 300 series stainless steel with keyway for positive positioning of impeller. Motors using carbon steel shafts or stainless stub shafts not be considered equal.
- J. Impeller be multi-vane design, constructed of bronze, accurately machined and dynamically balanced to job site conditions. Impeller will not require use of wearing rings to insure proper operation and be capable of passing 4-inch minimum solids.
- K. Double mechanical seal system be furnished and housed in machined cast iron seal chamber filled with clean dielectric oil, providing constant lubrication. Lower seal surfaces be of solid silicon carbide to provide longer life. Carbon ceramic, tungsten carbide or systems that allow lower seal surfaces to come in contact with pumped media, not be considered equal.

- L. Each pump be tested and computer generated report will be kept in file and made available upon request. Reported test data consists of six duty points of various heads and capacities, one of which will be design point and includes actual efficiencies and horsepower requirements.
- M. Furnish remote packaged factory pre-wired duplex pump controller with following:
 - 1. NEMA 1 double door dead front steel lockable enclosure.
 - 2. Magnetic starter with overload reset through cover, each pump.
 - 3. Fused disconnect switch with handle through cover, each pump.
 - 4. Automatic alternator, separately fused with lead/lag/alternating capacity.
 - 5. Overload reset buttons, each pump.
 - 6. Running lights, each pump.
 - 7. H-O-A switches, each pump.
 - 8. Control circuit transformer for 120V operation for each pump.
 - 9. Output connections for hi-water annunciation.
 - 10. Alarm silencing switch.
 - 11. Alarm light with flasher.
 - 12. Numbered and wired terminal strip.
 - 13. Single point electrical connection.
 - 14. Wiring between control panel and pump provided under Division 22, Plumbing.
- N. Sump Basin:
 - 1. Concrete vault and access covers provided under Division 03, Concrete work.
- O. Basin Cover:
 - 1. Fabricate with openings with gaskets, seals, and bushings, for access to pumps, pump shafts, control rods, discharge piping, vent connections, and power cables.
 - 2. Material: Steel, with bitumastic coating or cast iron.
 - 3. Reinforcement: Steel or cast-iron reinforcement capable of supporting foot traffic.
- P. Control Switches:
 - 1. Furnish and install mercury float switches complete with galvanized rod and wall support bracket. Each pump control switch will consist of 2 c normally open mercury switches, encapsulated in epoxy resin. Float casing will be polypropylene. Switch cable will be type STO PVC jacket 4 #18 conductor. 41 strand, 600 volt insulation. Cable will be secured to support rod with polypropylene composition clamp with stainless steel bolts. Switches used for high water alarm service will be of same construction as pump switches, except that 2 conductor cables will be furnished. Switch housing will be color coded to distinguish between pump and alarm switches.
- Q. Operation of Pumps:
 - 1. See Drawings for switch elevation settings.
 - 2. Switch 1 turns lead pump off at 6-inches above bottom of vault.

2.8 DUPLEX SEWAGE EJECTOR PUMP

- A. System: Sanitary Sewer.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Furnish and install where shown on Drawings, one duplex submersible sewage ejector system with UL rated explosion proof motors and a control panel rated for explosion proof motors.
- D. Pump casing one piece cast iron constructed with tripod support legs that provide an even distribution of weight.

- E. Mating surfaces between motor end bell, motor shell and seal chamber be sealed by means of Section AL Quad rings. Designs using conventional circulate 'O' rings or rectangular cross Sectional gaskets not to be considered equal.
- F. Pump motor be vertical, NEMA-6 and of an air filled, hermetically sealed design for premium efficiency. Oil filled shell not considered equal.
- G. Motor end bell cast iron, design as terminal box and separated from motor shell by combination bearings support and inspection plate.
- H. Motor housed within water tight, heavy duty cast iron with integral extended cooling fins. Motor have Class 'F' insulation and permanently lubricated, double sealed ball bearings having minimum life of 17,500 hours. Motors using sleeve type bearings not considered equal.
- I. Motor shaft 300 series stainless steel with keyway for positive positioning of impeller. Motors using carbon steel shafts or stainless stub shafts not considered equal.
- J. Impeller multi-vane design, constructed of bronze, accurately machined and dynamically balanced to job site conditions. Impeller not required use of wearing rings to insure proper operation and capable of passing 4-inch minimum solids.
- K. Double mechanical seal system furnished and housed in machined cast iron seal chamber filled with clean dielectric oil, providing constant lubrication. Lower seal surfaces solid silicon carbide to provide longer life. Carbon ceramic, tungsten carbide or systems that allow lower seal surfaces to come in contact with pumped media, not considered equal.
- L. Each pump tested and computer generated report will be kept in file and made available upon request. Reported test data consists of six duty points of various heads and capacities, one of which will be design point and includes actual efficiencies and horsepower requirements.
- M. Ejector Basin:
 - 1. Concrete vault and access covers provided under Division 03, Concrete work.
- N. Furnish remote packaged factory pre-wired alternative duplex explosion proof pump controller with the following:
 - 1. NEMA 1 double door dead front steel lockable enclosure.
 - 2. Magnetic starter with overload reset through cover, each pump.
 - 3. Fused disconnect switch with handle through cover, each pump.
 - 4. Automatic alternator, separately fused with lead/lag/alternating capacity.
 - 5. Overload reset buttons, each pump.
 - 6. Running lights, each pump.
 - 7. H-O-A switches, each pump.
 - 8. Controller provided with electronic devices to control flow alarm switches on four designated hydrostatic relief pipes. In event of an alarm sewage ejector system will shut down. Controller be provided with Manual Reset switch. Automatic reset is prohibited for this operating system. Provide summary output alarm contact set to signal sewage ejector system shut down to building information system.
 - 9. Control circuit transformer for 120V operation for each pump.
 - 10. Output connections for hi-water annunciation.
 - 11. Alarm silencing switch.
 - 12. Alarm light with flasher.
 - 13. Numbered and wired terminal strip.
 - 14. Single point electrical connection.
 - 15. Wiring between control panel and pump provided under Division 22, Plumbing.
- O. Duplex Pump Control:
 - 1. Furnish and install mercury float switches complete with galvanized rod and wall support bracket. Each pump control switch will consist of 2 normally open mercury switches,

encapsulated in epoxy resin. Float casing will be polypropylene. Switch cable will be type STO PVC jacket 4 #18 conductor. 41 strand, 600 volt insulation. Cable will be secured to support rod with polypropylene composition clamp with stainless steel bolts. Switches used for high water alarm service will be of same construction as pump switches, except that 2 conductor cables will be furnished. Switch housing will be color coded to distinguish between pump and alarm switches.

2.9 PACKAGED DOMESTIC BOOSTER PUMP SYSTEM WITH VARIABLE SPEED DRIVE

- A. System: Domestic Cold Water
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Furnish and install prefabricated water pressure booster system. System capable of automatically providing constant system pressure.
- D. Pressure for booster pump package shall be set at 35 PSI - 4-feet above top of highest roof level.
- E. System factory assembled, wired, electrically tested, hydrostatic pressure tested and shipped ready for field piping connection and wiring. Field startup by manufacturer is required for final acceptance.
- F. Factory Test Certification: Factory certifies in writing that water pressure booster system and its component parts have undergone complete electric and hydraulic test prior to shipment. Test includes system operating flow test from zero to 100 percent design flow rate under specified suction and net system pressure conditions. Certification includes copies of test data as recorded by X-Y plotter. System test may be witnessed by Architect by reporting intent to do so to factory.
- G. System furnished with suction and discharge headers constructed of welded stainless steel Schedule 10 pipe. Header pipe sizing designed for maximum of 8 fps velocity. Connections to headers flanged. Pipe welding performed by ASME Section IX certified welders. Piping built to ASME/ANSI B31.9 specifications.
- H. Pressure gauges supplied on suction and discharge manifold headers and provided with stainless steel cases, glycerin filled, and rated for plus 1 or minus 1 percent accuracy. Gauges selected for operation at mid-scale.
- I. System furnished with three pumps as listed on project schedule. Standard Bell and Gossett Series 1531 single stage centrifugal pumps with bronze-fitted construction and internally flushed mechanical seals. Pump casings to have vent and drain ports at top and bottom of casings.
- J. Each pump fitted with isolation valves and union connections or flanges to facilitate future service requirements. Each pump furnished with silent check valve with bronze trim.
- K. Common pump discharge header includes thermally activated purge valve built into header system for booster pumps to allow water to be purged to remote drain in event of system control failure.
- L. Single point disconnect panel skid mounted and factory wired. Factory wiring includes variable frequency drive wiring, motor wiring, differential pressure switch wiring and low suction pressure switch wiring. Pressure transducer shipped loose for field installation at high point in system as standard for optimal performance. Transducer located next to hydropneumatic tank at 31st Level.
- M. An ITT Bell and Gossett Technologic 500 Pump Logic Controller provided as pressure booster control panel. This is to be combination Pump Controller and Variable Frequency Drive in single enclosure.
- N. Technologic pump logic controller assembly listed by and bear label of Underwriter's Laboratory, Inc. (UL) and Canadian Underwriter's Laboratory (CUL) and CE marked. Controller specifically designed for variable speed pump applications. Controller functions to proven program that safeguards against damaging hydraulic conditioning including:
 - 1. Pump flow surges.
 - 2. Hunting
 - 3. Low suction pressure.

4. System over pressure.
- O. Pump logic controller microcomputer based and hold its software in EPROM. On-line field modified data entries, such as setpoint, stored in EEPROM. EEPROM memory storage prevents accidental loss of data due to voltage surge or spike. In event of complete power outage, field preset values remain stored and able to be recalled by operator.
- P. Pump logic controller capable of receiving up to two discrete analog inputs from transmitters indicated on Drawings. It will then select analog signal that has deviated greatest amount from its setpoint. This selected signal will be used as command feedback input for hydraulic stabilization function to minimize hunting. Each input signal capable of maintaining different set point value. Controller capable of controlling up to three pumps in parallel. Scan and compare rate that selects command setpoint and process variable signal continuous and automatically set for optimum operation. Each sensor scanned every 2 milliseconds.
- Q. Controller have fused door interlock disconnect, local-off-remote switch, motor overload protection, diagnostic display, manual and automatic alternation, auto start of lag pump on lead failure and accept pump differential pressure switch signals for pump fail notification.
- R. External transmitters furnished by ITT Bell and Gossett powered by Technologic Pump Logic Controller through quality integral 24 volt dc power supply and protected from reverse polarity of analog inputs. Overvoltage and short circuit protection on board. Hydraulic stabilization programs utilize proportional integral derivative control function. Proportional, integral and derivative values user adjustable over an infinite range. Pump logic controller self prompting. Fault messages displayed in plain English. Operator interface have following features:
1. Multi-fault memory and recall of last 10 faults and related operational data.
 2. Red fault light, Yellow warning light, and Green power on light.
 3. Soft-touch membrane keypad switches.
- S. Display four lines, with 20 characters on three lines and eight large characters on one line. Actual pump information displayed indicating pump status.
- T. Controller capable of performing the following pressure booster functions:
1. Low suction pressure cut-out to protect pumps against operating with insufficient suction pressure. This function resets automatically.
 2. High system pressure cut-out to protect piping system against high pressure conditions. This function requires manual reset.
 3. No flow shut down to turn the pumps off automatically when system demand is low enough to be supplied by hydropneumatic tank. No flow shutdown requires external flow meters, flow switches, no pressure switches to determine when no flow condition exists.
- U. The following hardwire communication features provided to BAS:
1. Remote system start/stop non-powered digital input.
 2. Failure of any system component. Output closes to indicate alarm condition.
 3. One 4-20 mA output with selectable output of:
 - a. Frequency
 - b. Process Variable
 - c. Output Current
 - d. Output Power
- V. Entire booster system, including piping, wiring, and controls, UL listed.
- W. Entire system pre-assembled onto heavy duty structural steel frame constructed of 4-inch minimum angle iron with channel iron pump bases. Frame welded in accordance with AWS D1.1 Specifications. Frame includes sturdy lifting and bolt-down clips.
- X. Provide remote hydropneumatic tank for domestic water system and included as part of booster pump system.

- Y. Components pre-piped, wired, and tested prior to shipment. System hydrostatic tested, cleaned, flushed, and painted with an industrial grade of epoxy based enamel.
- Z. Field plumbing connections required will be system suction and discharge headers, temp probe drain line, piping of hydropneumatic pressure tank with union ball valve, pressure gauge and drain provided.
- AA. Field electrical connections required will be input power supply to the control panel and remote pressure transducer control wiring.
- AB. Coordinate location of unit and electrical characteristics with Division 26, Electrical work.
- AC. Unit mounted on housekeeping pad. Provide seismic anchor calculations for this equipment, stamped and signed by Licensed Oregon State Structural Engineer.
- AD. Manufacturer's representative provides system check and start-up service for the system.

2.10 HYDRO-PNEUMATIC TANK FOR BOOSTER PUMP SYSTEM

- A. System: Domestic Water Booster Pump.
- B. Entire unit is to be delivered complete with operating controls and require only plumbing and electrical service connections.
- C. Remote hydro-pneumatic tank for booster pump system included loose with packaged BP-1 system.
- D. Tank fully acceptance replaceable bladder style and include union isolation valve, tank drain, pressure gauge and drain valve. Tank shipped loose for field installation as indicated on the Drawings.

2.11 EXTERIOR GREASE INTERCEPTOR - LARGE CAPACITY

- A. Prefabricated concrete unit:
 - 1. Prefabricated reinforced concrete with H-20 traffic load with minimum of 2-feet of soil cover, two compartment, two concrete access risers with 24-inches diameter gas and water tight manhole covers, 4-inch inlet and 4-inch outlet. Unit set on level compacted or undisturbed soil.
- B. Pre-fabricated steel unit.
 - 1. Large capacity acid resistant coated interior and exterior fabricated steel unit with air relief, cleanout plug, double wall trap seal, nonskid cover, flow control fitting, sensor grease level control box. Unit level on crete pit. Reference detail on construction drawings.

2.12 LINT TRAP - LAUNDRY

- A. Contractor to provide formed concrete trench for laundry machine discharge, ad detailed on drawings.
- B. Lint traps: Custom corrosion resistant removable stainless steel screens with 3/32-inches proportions.
- C. Lint trap cover: 24-inches by 24-inches square gratings, 2-inch thick, 165 pounds each, perma grip surface.
- D. Drain: 12-inches by 12-inches, 6-inches outlet.
- E. Reference detail on construction drawings.

END OF SECTION

SECTION 224000 PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Plumbing Fixtures:
 - a. China Fixtures, White Only
 - b. Enameled Steel Fixtures, White Only
 - c. Faucet Fittings
 - d. Fiberglass Fixtures, White Only
 - e. Hose Reels
 - f. Molded Resin or Stone Fixtures
 - g. Shower Valves
 - h. Stainless Steel Fixtures
 - i. Thermostatic Mixing Valves
 - j. Trench Drains
 - 2. Carriers
 - 3. Downspout Boot/Nozzle/Cover
 - 4. Drinking Fountains
 - 5. Electric Water Coolers
 - 6. Emergency Showers/Eyewash
 - 7. Fixture Trim
 - 8. Floor Drains
 - 9. Floor Sinks
 - 10. Flushometers - Water Closet/Urinal
 - 11. Hose Bibbs
 - 12. Hub Drains
 - 13. Kitchen Equipment
 - 14. Roof/Overflow Drains
 - 15. Water Closet Seats
 - 16. Drain Boxes

1.2 RELATED SECTIONS

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

1.3 REFERENCES AND STANDARDS

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

1.4 SUBMITTALS

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

1.5 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.

1.6 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

2.1 MANUFACTURERS

- A. "Or approved equivalent" as defined in 22 00 00, General Plumbing Requirements. Substitution process requirements apply to approved equivalent products.
- B. General Plumbing Fixtures: See Schedule on Drawings for type.
1. China Fixtures - White Only:
 - a. American Standard
 - b. Briggs
 - c. Crane
 - d. Eljer
 - e. Kohler
 - f. Universal-Rundle
 - g. Or approved equivalent.
 2. Enameled Steel Fixtures - White Only:
 - a. American Standard
 - b. Briggs
 - c. Crane
 - d. Eljer
 - e. Kohler
 - f. Universal-Rundle
 - g. Or approved equivalent.
 3. 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.
- 4. Fiberglass Fixtures - White Only:
 - a. Aqua-Glass
 - b. Briggs
 - c. Crane
 - d. Fiber-Fab
 - e. Hytec
 - f. Mustee
 - g. Universal-Rundle
 - h. Or approved equivalent.
- 5. Hose Reels:
 - a. Balcrank
 - b. Lincoln
 - c. Or approved equivalent.
- 6. Molded Resin or Stone Fixtures:
 - a. Fiat
 - b. Mustee
 - c. Stern Williams
 - d. Or approved equivalent.
- 7. Shower Valves:
 - a. Acorn
 - b. Chicago
 - c. Delta
 - d. Moen
 - e. Powers
 - f. Symmons
 - g. Or approved equivalent.
- 8. Stainless Steel Fixtures:
 - a. Elkay
 - b. Haws
 - c. Just
 - d. Or approved equivalent.
- 9. Thermostatic Mixing Valves:
 - a. Bradley
 - b. Powers
 - c. Symmons
 - d. Or approved equivalent.
- 10. 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. Downspout Boot/Nozzle/Cover:

1. JR Smith
 2. Mifab
 3. Sioux Chief
 4. Zurn
 5. 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. Emergency Showers/Eyewash:
1. Bradley
 2. Encon
 3. Guardian
 4. Haws
 5. Speakman
 6. Or approved equivalent.
- H. Fixture Trim:
1. McGuire
 2. Or approved equivalent.
- I. Floor Drains:
1. Mifab
 2. Sioux Chief
 3. Smith
 4. Wade
 5. Watts
 6. Zurn
- J. Floor Sinks:
1. Commercial Enameling
 2. Mifab
 3. Sioux Chief
 4. Smith
 5. Wade
 6. Watts
 7. Zurn
 8. Or approved equivalent.

K. Flushometers - Water Closet/Urinal:

1. Delaney
2. Sloan
3. Zurn
4. Or approved equivalent.

L. Hose Bibbs:

1. Chicago
2. JR Smith
3. Mifab
4. Wade
5. Woodford
6. Zurn
7. Or approved equivalent.

M. Hub Drains:

1. JR Smith
2. Zurn
3. Or approved equivalent.

N. Kitchen Equipment:

1. No products specified. See Part 3 "Kitchen Equipment" article below for additional information.

O. Roof/Overflow Drains:

1. JR Smith
2. Mifab
3. Sioux Chief
4. Watts
5. Zurn
6. Or approved equivalent.

P. Water Closet Seats:

1. Bemis
2. Or approved equivalent.

Q. Drain Boxes:

1. Sioux Chief
2. Or approved equivalent.

2.2 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 Flow Rates:

1. Water Closets: Single flush 1.28 GPF or dual flush at 1.6/1.1 GPF.
2. Lavatories in public core areas to be set for 0.5 GPM max. Other lavatories to be 1.0 GPM flow.
3. Sinks to be set for 1.5 GPM flow max.
4. Showers factory set at a maximum of 1.8 - 2 GPM flow.

2.3 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 913). Coupling type or plate type with bearing plate 300 lb. capacity.

C. Wall Hung Lavatory: Zurn Z-1231 (D). (JR Smith 700). Connected arm, 250 lb. capacity.

D. Wall Hung Service Sink: Zurn Z-1218. (JR Smith 913/914). Coupling type.

E. Wall Hung Drinking Fountain: Z-1225-BL (JR Smith 834-97-98). Plate type.

F. 750 lb. Carrier for Water Closet:

1. Adjustable vertical type.
2. Adjustable horizontal type.

2.4 DOWNSPOUT BOOT/NOZZLE/COVER

A. See Schedule on Drawings for type.

2.5 DRINKING FOUNTAINS

A. See Schedule on Drawings for type.

2.6 ELECTRIC WATER COOLERS

A. See Schedule on Drawings for Type.

2.7 EMERGENCY SHOWERS/EYEWASH

A. Provide emergency showers/eyewash products that are compliant with ANSSI Z358.1, Standards for Emergency Eyewashes and Shower Equipment.

2.8 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: Loose key type.

1. Lavatory: McGuire LFH 2165 CK
2. Sink: McGuire LFH 2167 LK
3. Water Closets: McGuire

C. Grid strainer: McGuire 155A.

D. Sink strainer: McGuire 152N.

- E. Trim barrier-free wrap for P-traps and supplies by McGuire, Pro-Wrap, Plumberex or True-bro.
- F. Escutcheons: McGuire wrought brass deep bell.
- G. Wax Rings and Toilet Bolts: WM Harvey No Seep No. 1 053065-N.

2.9 FLOOR DRAINS

- A. See Schedule on Drawings for types.

2.10 FLOOR SINKS

- A. See Schedule on Drawings for types.
- B. Plastic components are not allowed.

2.11 FLUSHOMETERS - WATER CLOSET/URINAL

- A. See Schedule on Drawings for types.

2.12 HOSE BIBBS

- A. See Schedule on Drawings for types.

2.13 HUB DRAINS

- A. See Schedule on Drawings for type.

2.14 KITCHEN EQUIPMENT

- A. No products specified. See Part 3 "Kitchen Equipment" article below for additional information.

2.15 ROOF/OVERFLOW DRAINS

- A. See Schedule on Drawings for type.
- B. Plastic components are not allowed.

2.16 WATER CLOSET SEATS

- A. See Schedule on Drawings for type.

2.17 DRAIN BOXES:

- A. See Schedule on Drawings for Type.

END OF SECTION

SECTION 230000
HEATING, VENTILATING AND AIR CONDITIONING (HVAC) BASIC
REQUIREMENTS

PART 1 GENERAL

1.1 DESIGN-BUILD SUMMARY OF WORK

- A. Work included in 23 00 00 applies to Division 23, HVAC work to provide materials, labor, tools, permits and incidentals to make heating, ventilation and air conditioning systems ready for Owner's use for proposed project.

1.2 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.

1.3 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.
- D. 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.

1.4 DESIGN-BUILD DESIGN CRITERIA/CALCULATIONS

- A. Design Criteria:
 - 1. HVAC:
 - a. Temperatures:
 - 1) Cooling:
 - (a) 72 Degrees F DB, 63 Degrees F WB Inside Design
 - (b) 93 Degrees F DB, 67 Degrees F WB Outside Design
 - 2) Heating:
 - (a) 70 Degrees F DB Inside Design
 - (b) 10 Degrees F DB Outside Design
 - 3) Lighting: 1.0 w/sf.
 - 4) Miscellaneous Electrical Load: 1.5 w/sf.
 - b. Acoustical Requirements: Sound generated by HVAC system in occupied zone of a treated space not-to-exceed noise criterion of NC-35.
 - c. Provide exhaust systems to toilet and janitor's rooms. The exhaust systems provide a minimum of 10 air changes per hour.
 - d. Provide drawings with duct layout, exhaust fans, A/C units, size, and description of equipment, heating/cooling load calculations, equipment selections, etc. for review and for permit process. Coordinate ceiling diffuser locations with Architectural Drawings and Lighting Plan.

- e. Outside air ventilation to be designed per current state ventilation code or ASHRAE recommendations, whichever is greater.
 - f. Provide calculations and installation details of equipment mounting to structure to conform to local seismic codes. Calculations and details to be included on Drawings as a part of submittal process.
 - g. Provide equipment and/or devices for pressure control of spaces so as not to over pressurize space.
 - h. Provide independent cooling only split systems for elevator equipment rooms.
2. Controls:
- a. Complete bidder designed temperature control system as described in these specifications. Building Automation System (BAS) Manufacturer to furnish and install a fully integrated building automation system, incorporating direct digital control (DDC) for energy management, equipment monitoring and control, and subsystems.
 - b. Materials and equipment used to be standard components, regularly manufactured for this and other systems and not custom designed specially for this project. Provide systems and components thoroughly tested and proven in actual use for at least 2 years.
 - c. Provide line and low voltage wiring for a complete and operable system. Wiring in accordance with local, State and National Codes.
 - d. DDC controller programmed through a personal computer (PC) with printer, alarm reporting and graphics. PC includes a modem.
 - e. Provide controllers for equipment unless specifically specified otherwise. Coordinate with equipment suppliers.
 - f. Provide system capable of handling equipment scheduled and shown on Drawings.
3. Air Distribution Duct System:
- a. General: Provide ductwork, including collars, register boxes, fire dampers, fire/smoke dampers, exhaust fans, ventilation louvers, roof vents and screens, as well as dampers and other miscellaneous items not specifically mentioned but necessary for a complete installation. Apply latest Standards of SMACNA and/or ASHRAE with respect to sheet metal gauge and general construction for round and rectangular ducts.
- B. Calculations:
1. HVAC:
- a. Submit heating and cooling load calculations per ASHRAE Standards for each HVAC zone.
 - b. Submit natural gas sizing calculations.
 - c. 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.

1.5 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 representative, and other reviewing entity whose approval is required to obtain systems acceptance.

1.6 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

1.7 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
- C. General: 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	Canadian Gas Association
17. CHPS	Collaborative for High Performance Schools
18. CISPI	Cast Iron Soil Pipe Institute
19. CSA	CSA International
20. EPA	Environmental Protection Agency
21. ETL	Electrical Testing Laboratories
22. FDA	Food and Drug Administration
23. FM	FM Global
24. GAMA	Gas Appliance Manufacturers Association
25. HI	Hydraulic Institute Standards
26. IAPMO	International Association of Plumbing & Mechanical Officials
27. IFGC	International Fuel Gas Code
28. ISO	International Organization for Standardization
29. LEED	Leadership in Energy and Environmental Design
30. MSS	Manufacturers Standardization Society
31. NEC	National Electric Code
32. NEMA	National Electrical Manufacturers Association
33. NFPA	National Fire Protection Association
34. NFGC	National Fuel Gas Code
35. NRCA	National Roofing Contractors Association
36. NSF	National Sanitation Foundation
37. OSHA	Occupational Safety and Health Administration
38. SMACNA	Sheet Metal and Air Conditioning Contractors' National Association, Inc.
39. TEMA	Tubular Exchanger Manufacturers Association
40. TIMA	Thermal Insulation Manufacturers Association
41. UL	Underwriters Laboratories, Inc.
42. USDA	United States Department of Agriculture
43. USGBC	United States Green Building Council

D. See Division 23, HVAC individual Sections for additional references.

E. 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.

F. 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.

G. Piping and duct insulation products to contain less than 0.1 percent by weight PBDE in all insulating materials.

1.8 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 Exceptions 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 or posted to ftp site. For electronic format, provide one zip file per specification division containing a separate file for each specification Section. Individual submittals sent piecemeal in a per Specification Section method will be returned without review or comment. Copy Architect on all transmissions/submissions.
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. 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 230548, Vibration and Seismic Controls for HVAC Equipment. Provide engineered seismic drawings and equipment seismic certification. Equipment Importance Factor as specified in Part 3 of this Section.
7. 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.
8. Make provisions for openings in building for admittance of equipment prior to start of construction or ordering of equipment.
9. 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.

10. 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.
11. Samples: Provide samples when requested by individual Sections.
12. 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 exceptions 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.
13. Operation and Maintenance Manuals, Owners Instructions:
 - a. Submit, at one time, electronic files (PDF format) on CD/DVD 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.
14. 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.

1.9 QUALITY ASSURANCE

- A. Regulatory Requirements: Work and materials installed to conform with all local, State, Federal and other applicable laws and regulations.
- B. 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.
- C. Manufacturer's Instructions: Follow manufacturer's written instructions. If in conflict with Contract Documents, obtain clarification. Notify Engineer/Architect, in writing, before starting work.
- D. Items shown on Drawings are not necessarily included in Specifications or vice versa. Confirm requirements in all Contract Documents.
- E. UL and CSA Compliance: Provide products which are UL listed.
- F. 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.
- G. 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, prepare and submit coordinated layout drawings (composite drawings), to coordinate installation and location of ductwork, grilles, diffusers, piping, fire sprinklers, plumbing, lights, and electrical services. Composite Drawings show services on single sheet. Key Drawings to structural column identification system. Prior to completion of Drawings, coordinate proposed installation with architectural and structural requirements, and other trades (including plumbing, HVAC, fire protection, electrical, ceiling suspension, and ceiling tile systems, etc.), 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. Unless otherwise required by Division 00, Procurement and Contracting Requirements and/or Division 01, General Requirements, Division 23, HVAC to combine information furnished by other trades onto master coordination documents.
- B. Prepare Drawings as follows:
 - 1. Drawings in CAD Format. CAD format release equal to design documents. Drawings to be same sheet size and scale as Contract Drawings and indicate location, size and elevation above finished floor of equipment and distribution systems.
 - 2. Review and revise, as necessary, Section cuts in Contract Drawings after verification of field conditions.
 - 3. Indicate hydronic and air distribution system piping including fittings, hangers, access panels, valves, and bottom of pipe and duct elevations above finished floor.
 - 4. Indicate inverts and provision for piping that must be graded to have right-of-way over more flexible items. Drawings also to indicate proposed ceiling grid and lighting layout as shown on electrical drawings and architectural reflected ceiling drawings and HVAC equipment, ductwork and piping.
 - 5. Incorporate Addenda items and change orders.
 - 6. Distribute drawings to trades and provide additional coordination as requested by other trades.
- C. Advise Architect in event conflict occurs in location or connection of equipment. Bear costs resulting from failure to properly coordinate installation or failure to advise Architect of conflict.
- D. 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.
- E. Submit final Coordination Drawings with changes as Record Drawings at completion of project.

1.12 LEED REQUIREMENTS

- A. Project seeks LEED certified status, as outlined by the United States Green Building Council (www.usgbc.org).
- B. Obtain list of credits sought by project. Be familiar with requirements for credits. See Division 00, Procurement and Contracting Requirements and Division 01, General Requirements for additional requirements.
- C. Provide materials and services as outlined in appropriate LEED Reference Guide.
- D. Provide documentation as outlined in appropriate LEED Reference Guide.
- E. Coordinate start-up, testing, training, and installation with Commissioning Agent as required to meet commissioning requirements.
- F. Provide adequate schedule for construction activities such as building flush out.

- G. Project is seeking EQc3.2: Construction Indoor Air Quality Management Plan - Before Occupancy. Achieve credit by performing and documenting Option 1 - Flushout or Option 2 - Air Testing.
1. Option 1 - Flushout:
 - a. Provide design team with EQc3.2 flushout plan with the following information:
 - 1) Space-by-space flushout calculations with anticipated flushout period.
 - 2) Calculations showing HVAC system is capable of maintaining space conditions of 60 degrees F dry bulb and a maximum of 60 percent relative humidity at stated air flow rates and flushout time of year.
 - 3) Information to be trended.
 - 4) Method of documenting compliance.
 - 5) Flushout period coordinated with construction schedule.
 - b. Flushout plan must be reviewed and approved before Division 23 submittals will be approved.
 2. Option 2 - Air Testing:
 - a. Hire third party specialized air quality contractor to conduct test.
 - b. Air quality contractor to provide design team with EQc3.2 air quality testing plan. Air quality testing plan must be reviewed and approved before Division 23 submittals will be approved.
 - c. If air quality test fails, perform Option 1-Flushout to achieve credit.
 - d. Provide additional temporary equipment required for flushout, including but not limited to:
 - 1) Humidity Sensors
 - 2) Fans
 - 3) Opening Block Off
 - 4) Fans and Temporary Heating Equipment
 3. Coordinate flushout or air testing period with Owner, design team and applicable disciplines.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide like items from one manufacturer, including but not limited to pumps, fans, valves, control devices, air handlers, vibration isolation devices, etc.

2.2 MATERIALS

- 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. Articles, fixtures, and equipment of a kind to be standard product of one manufacturer.
- C. Names and manufacturer's names denote character and quality of equipment desired and are not to be construed as limiting competition.
- D. 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.

2.3 ACCESS PANELS

- A. See Division 01, General Requirements and Division 08, Openings for products and installation requirements.

- B. Confirm Access Panel requirements in Division 01, General Requirements, Division 08, Openings and individual Division 23, HVAC Sections. In absence of specific requirements in Division 01, General Requirements, comply with the following:
 - 1. Provide flush mounting access panels for service of systems and individual components requiring maintenance or inspection. Where access panels are located in fire-rated assemblies of building, rate access panels accordingly.
 - a. Ceiling access panels to be minimum 24-inch by 24-inch required and approved size.
 - b. Wall access panels to be minimum of 12-inch by 12-inch required and approved size.
 - c. Provide screwdriver operated catch.
 - d. Manufacturers and Models:
 - 1) Drywall: Karp KDW.
 - 2) Plaster: Karp DSC-214PL.
 - 3) Masonry: Karp DSC-214M.
 - 4) 2 hour rated: Karp KPF-350FR.
 - 5) Manufacturers: Milcor, Elmdor, Acudor or approved equivalent.

PART 3 EXECUTION

3.1 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. Coordinate work 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. 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.

3.2 SEISMIC CONTROL

- A. Confirm Seismic Control requirements in Division 01, General Requirements, Section 230548, Vibration and Seismic Controls for HVAC Equipment, Section 23 00 00, HVAC Basic Requirements and individual Division 23 HVAC Sections.
- B. Equipment Importance Factor: 1.0.
- C. General:
1. Confirm Building Risk Category and Seismic Design Category with Architect and Structural Engineer.
 2. Earthquake resistant designs for HVAC (Division 23) equipment and distribution, i.e. motors, ductwork, piping, equipment, etc. conform to regulations of jurisdiction having authority.
 3. 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.
 4. Provide stamped Shop Drawings from licensed Structural Engineer of seismic bracing and seismic movement assemblies for piping equipment and water heaters. Submit Shop Drawings along with equipment submittals.
 5. Provide stamped Shop Drawings from licensed Structural Engineer of seismic flexible joints for piping and crossing building expansion or seismic joints. Submit Shop Drawings along with seismic bracing details. Coordinate exact design requirements with project Structural Engineer.
- D. Piping and Ductwork:
1. Per "Seismic Restraints Manual Guidelines for Mechanical Systems" latest edition published by SMACNA or local requirements.
- E. Equipment:
1. Provide means to prohibit excessive motion of equipment during earthquake.

3.3 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. Costs incurred by additional trips required due to incomplete systems will be the responsibility of the Contractor.

3.4 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.

3.5 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.

3.6 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.

3.7 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.

3.8 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 Representative, Architect and Engineer and Commissioning Agent 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.
- D. Training and Demonstration per Division 01 specifications for General Commissioning Requirements.

3.9 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 ACCESS PANELS

- A. Confirm Access Panel requirements in Division 01, General Requirements. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Coordinate locations/sizes of access panels with Architect prior to work.

3.13 DEMOLITION

- A. Confirm requirements in Division 01, General Requirements and Division 02, Existing Conditions. In absence of specific requirements, comply with individual Division 23, HVAC Sections and the following:
 - 1. Scope:
 - a. It is the intent of these documents to provide necessary information and adjustments to the HVAC system required to meet code, and accommodate installation of new work.
 - b. Coordinate with Owner so that work can be scheduled not to interrupt operations, normal activities, building access or access to different areas.
 - c. Existing Conditions: Determine exact location of existing utilities and equipment before commencing work, compensate Owner for damages caused by failure to exactly locate and preserve utilities. Replace damaged items with new material to match existing. Promptly notify Owner if utilities are found which are not shown on Drawings.
 - 2. Equipment: Unless otherwise directed, equipment, fixtures, or fittings being removed as part of demolition process are Owner's property. Remove other items not scheduled to be reused or relocated from job site as directed by Owner.

3. Unless specifically indicated on Drawings, remove exposed, unused ductwork and piping to behind finished surfaces (floor, walls, ceilings, etc.). Cap and patch surfaces to match surrounding finish.
4. Unless specifically indicated on Drawings, remove unused equipment, fixtures, fittings, rough-ins, and connectors. Removal is to be to a point behind finished surfaces (floors, walls, and ceilings).

3.14 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

3.15 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.

3.16 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.

3.17 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.

3.18 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 insure 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 230513 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Starters
 - 2. Shaft Grounding
 - 3. Motors

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 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.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 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.

1.6 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

2.1 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.

2.2 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.
8. Motor starters for equipment not installed in Division 26, Electrical, Section 26 24 19 "Motor Control" to be furnished and installed by Division 23, HVAC.

2.3 SHAFT GROUNDING

- A. Variable Speed Motor Shaft Grounding: Shaft grounding ring.

2.4 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 230519 METERS AND GAUGES FOR HVAC PIPING

PART 1 GENERAL

1.1 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

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 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

2.1 MANUFACTURERS

- A. Pressure Gauges:
 - 1. Dwyer Instruments, Inc.
 - 2. Moeller Instrument Co., Inc.
 - 3. Omega Engineering, Inc.
 - 4. Trerice

5. Or approved equivalent.
- B. Thermometers:
 1. Ashcroft
 2. Trerice
 3. Weiss
 4. Marshalltown
 5. Weksler
 6. Or approved equivalent.
- C. Differential and Filter Pressure Gauges:
 1. Dwyer
 2. Or approved equivalent.

2.2 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 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.
 9. Basis of Design: Trerice Model 600CB.

2.3 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.

2.4 DIAL THERMOMETERS

- A. Thermometers: 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.
 6. Basis of Design: Trerice Model 80742.

2.5 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.

2.6 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.

2.7 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.

2.8 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.

2.9 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 230523 GENERAL-DUTY VALVES FOR HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Valves, General
 - 2. Globe Valves
 - 3. Balancing Valves
 - 4. Ball Valves
 - 5. Butterfly Valves
 - 6. Swing Check Valves

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 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

2.1 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.
 - 2. Butterfly Valves: With extended neck.
- 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.
 - b. Pipe Sizes 4-inches and Larger: Butterfly valve. Gate valve acceptable if allowed by Owner.
 - 2. Drain Service; All Pipe Sizes: Ball valves.
 - 3. Strainer Blow-Off: Ball valve.
 - 4. Bypass Around Pressure-Reducing Valves: Globe valves.
 - 5. Check Valves: Swing.
- F. Manufacturers: Crane, Griswold, Hammond, Hays, Jenkins, Milwaukee, Mueller, Nibco, Stockham, Tour Anderson, Watts. Note: See individual Sections for specialty valves (balancing valves, pressure regulators, relief valves, earthquake valves, gas valves). NIBCO Numbers shown as Basis of Design.

2.2 GLOBE VALVES

- A. 3-inches and Smaller: Class 200, 200 lb. SWP, MSS SP-80, ASTM B61, cast bronze body, bronze bonnet, bronze disc, bronze packing gland, non-asbestos packing and aluminum or malleable iron hand-wheel.

2.3 BALANCING VALVES

- A. Maximum 125 PSIG System Working Water Pressure.

2.4 BALL VALVES

- A. 2-1/2-inches and Smaller: MSS SP-110-80, 150 PSI, bronze body, threaded ends, brass or stainless steel ball, Teflon seat, bronze stem, extended steel handle, full port. Nibco T-595-Y.
- B. 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.

2.5 BUTTERFLY VALVES

- A. Select lug type valves.
- B. 6-inches and Smaller: 200 PSI, ductile iron body, extended neck, stainless steel stem with aluminum bronze disc, reinforced resilient EPDM seat, memory stop control, lever handle through 5-inches, size and worm gear operator for 6-inches and larger. Mount stem in horizontal position. Manual lever and lock Nibco LD2000 for mechanical coupling fittings. MSS SP-67, Type 1.
- C. 8-inches and Larger: 200 PSI, ductile iron body, extended neck, stainless steel disc and stem reinforced resilient EPDM seat, memory stop control, lever handle through 5-inches, size and worm gear operator for 6-inches and larger. Mount stem in horizontal position. Manual lever for mechanical coupling fittings. MSS SP-67, Type 1.

2.6 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.

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Hangers and Supports
 - 2. Pipe Hangers and Supports
 - 3. Building Attachments
 - 4. Flashing
 - 5. Miscellaneous Metal and Materials

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 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 manufacturers requirements and Code requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 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: 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.
 - a. 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.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. General - 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 230548.
- F. Obtain approval from AHJ for seismic restraint hanger and support system to be installed for piping and equipment. See Section 230548.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hangers and Supports:
 1. Anvil International
 2. B-Line Systems, Inc.
 3. Erico Co., Inc.
 4. Nelson-Olsen Inc.
 5. Rilco Manufacturing Co., Inc.
 6. Unistrut corp.
 7. Or approved equivalent.
- B. Pipe Hangers and Supports:
 1. Anvil International
 2. B-Line Systems, Inc.
 3. Erico Co., Inc.
 4. Nelson-Olsen Inc.
 5. Rilco Manufacturing Co., Inc.
 6. Snappitz Thermal Pipe Shield Manufacturing

7. Unistrut corp.
 8. Or approved equivalent.
- C. Building Attachments:
1. Anchor-It
 2. Gunnebo Fastening Corp.
 3. Hilti Corporation
 4. ITW Ramset/Red Head
 5. Masterset Fastening Systems, Inc.
 6. Or approved equivalent.

2.2 HANGERS AND SUPPORTS

- A. Hanger Rods:
1. 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:
1. 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. 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 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 tipped 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.

2.3 PIPE HANGERS AND SUPPORTS

- A. Pipe Hangers:
1. Pipe Rings for Hanger Rods: Pipe sizes 2-inch and smaller, Adjustable swivel ring hanger, UL listed. Erico 100 or 101, Anvil Figures 69 or 104, or approved equivalent. 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. Pipe hangers to have same finish as hanger rods.
- B. 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).
- C. Riser Clamps:
1. Steel, UL listed. MSS Type 8. Erico 510 or 511. Copper coated; Erico 368.
- D. Pipe Slides:
1. 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.
- E. 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 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.
- F. Pipe Roller Hangers:
1. Adjustable roller hanger. Black steel yoke, cast iron roller. MSS Type 41.
- G. 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.
- H. 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.
- I. Freestanding Roof Supports:
1. Polyethylene high-density UV resistant quick "pipe" block with foam pad.

2.4 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:
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.
- C. Anchor Bolts:
1. General: 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.

2.5 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.

2.6 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. 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: 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 230548

VIBRATION AND SEISMIC CONTROLS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Vibration Isolation
 - 2. Seismic Restraint Devices
 - 3. Factory Finishes
 - 4. 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.
 - a. No hanging from roof deck is permitted on this project, unless specifically allowed by Structural Engineer of Record in writing prior to bid.

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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 or Civil 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 or Civil 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. Air Mounting System Performance Certification: Include natural frequency, load, and damping tests performed by an independent laboratory or acoustician.
8. Equipment Certification:
 - a. Provide seismic certification for equipment as noted in Seismic Design Summary or schedules on Drawings.

1.5 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.
- 2) Seismic restraint of equipment, piping, and ductwork to be in accordance with Office of Statewide Health Planning and Development (OSHPD) requirements for State of California including Code Application Notices (CAN) and policy Intent Notices (PIN). Specifically adhere to CAN 2-1708A.5, CBC Sections 1708A.2, 1708A.5, 1702A and 1707A.9.
- b. Seismic Design Category:
 - 1) Confirm Seismic Design Category with Architect.
 - 2) Seismic Design Category: D for mechanical equipment and systems.
- c. Building Risk Category:
 - 1) Confirm Building Risk Category with Architect.
- d. Equipment Importance Factor: 1.0.
- e. 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 ASCE 7-10. Anchorage systems to bear 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 1 test or analysis at 45 degrees to weakest mode.
- f. 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.
- g. 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.
- h. 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 or Civil 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 or Civil Engineer who designed layout of braces.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 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

2.1 MANUFACTURERS

- A. Vibration Isolation:
 1. Amber/Booth
 2. B-Line Systems, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries Inc.
 5. M.W. Sausse - Vibrex
 6. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
 7. Or approved equivalent.
- B. Seismic Restraint Devices:
 1. Amber/Booth
 2. B-Line Systems, Inc.
 3. Hilti, Inc.
 4. Kinetics Noise Control, Inc.
 5. Mason Industries, Inc.
 6. California Dynamics Corporation
 7. Cooper B-Line Tolco.
 8. Unistrut Diversified Products Co.; Wayne Manufacturing Division.
 9. M.W. Sausse - Vibrex
 10. Or approved equivalent.
- C. Seismic-Bracing/Restraint Devices/Systems for Equipment, Piping and Ductwork:
 1. Amber-Booth
 2. California Dynamics Corporation
 3. Cooper B-Line, Inc.
 4. Hilti, Inc.
 5. Mason Industries, Inc.

6. Kinetics Noise Control.
7. Unistrut
8. ISAT, Inc.
9. Where Mason numbers are specified, equivalent products by listed manufacturers are acceptable.
10. Or approved equivalent.

2.2 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. 1/4-inch thick steel load distribution plate between layers and between pad and equipment, 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.
- 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:
 - a. Galvanized aircraft-type cable or control rods to prevent over extension.
 10. Basis of Design: Metraflex Doublesphere.

2.3 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. Mason Type: Z-1011 or Z-1225. Snubber load rating to match equipment size.
 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.
- E. Seismic Restraint Systems for Ductwork and Piping:
 1. Curb to have anchorage pre-approval "OPA" number from OSHPD in state of California attesting to maximum certified horizontal and vertical load ratings. Brace assemblies and rod clamps have an Anchorage Pre-approval "OPA" Number from OSHPD in State of California verifying maximum certified load ratings. Fire/smoke dampers, fire dampers or any other device with break away connections cannot be used for seismic restraint.

2.4 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. Kynar 500 Fluoropolymer Coating:
 - a. Conform to AAMA 605.2.
 - b. Apply coating following cleaning and pretreatment.
 - c. Cleaning: AA-C12C42R1X.
 - d. Dry system before final finish application.
 - e. Total Dry Film Thickness: Approximately 1.2 mils, when baked at 450 degrees F for 10 minutes.
- B. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.

1. Powder coating on springs and housings.
2. Hardware be electrogalvanized. Hot-dip galvanize metal components for exterior use.
3. Baked enamel for metal components on isolators for interior use.
4. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

2.5 SEISMIC-BRACING/RESTRAINT DEVICES/SYSTEMS FOR EQUIPMENT, PIPING, AND DUCTWORK

- A. General Requirements for Restraint Components: Rated strengths, features, and applications 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 230553
IDENTIFICATION FOR HVAC PIPING, DUCTWORK AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

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

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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.

1.5 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.

1.6 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

2.1 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.

2.2 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.

2.3 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.

2.4 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.

2.5 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 230593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. General Requirements and Procedures
 - 2. Ductwork Pressure Testing
 - 3. Fundamental Air Systems Balancing Procedures
 - 4. Temperature Control Verification
 - 5. Constant Volume Air Systems Balancing Procedures
 - 6. Kitchen and Dishwasher Hoods
 - 7. Heat Exchangers
 - 8. Pre-Balance Reporting
 - 9. Final Reports:
 - a. Report Requirements
 - b. General Report Data
 - c. System Diagrams
 - d. Air Handling Units
 - e. Refrigerant Coils
 - f. Fans
 - g. Duct Traverses
 - h. Diffusers/Registers/Grilles
 - i. Heat Exchangers
 - j. Instrument Calibration
 - 10. Additional Tests

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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 Agent and this Project's testing, adjusting, and balancing 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 all 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 testing, adjusting, and balancing 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 Testing, Adjusting, and Balancing Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by the testing, adjusting, and balancing Agent.
7. Sample Report Forms: Submit two sets of sample testing, adjusting, and balancing 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.

1.5 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. Acceptable Balance Firm:
 - a. General:
 - 1) Procure services of independent balance and testing agency which specializes in balancing and testing of plumbing, heating, ventilating, and air conditioning systems, to balance, adjust and test water circulating and air moving equipment and air distribution or exhaust systems. 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 testing, adjusting and balancing.
 - 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.
 - c. Test Observation: If requested, conduct tests in the presence of the Architect or the Architect's representative.
 2. Noise Criteria:
 - a. Noise levels in all 8 octave bands due to equipment and duct systems 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
Lobbies, Waiting Areas	35-40
Offices, Large Open (3 or more occupants)	35-40
Offices, Small Private (2 or fewer occupants)	30-35
Kitchens	40-45
Classrooms (Small, Medium, Large)	30-35
Cafeteria/Dining	35-40
Bedrooms	25-30
All Others	35-40

- b. For equipment which has no sound power ratings scheduled on the Drawings, select equipment that the foregoing noise criteria, local ordinance noise levels, and OSHA requirements are not exceeded. Selection procedure in accordance with ASHRAE Fundamentals Handbook, Chapter 7, Sound and Vibration.
 - c. 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.
 - d. In absence of specified measurement requirements, measure equipment noise levels three feet from equipment and at an elevation of maximum noise generation.
3. Allowable Vibration Tolerances for Rotating, Non-reciprocating Equipment: Not-to-exceed a self-excited vibration maximum velocity of 5 mm per second (0.20 inch per second) RMS, filter in, when measured with a vibration meter on bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. Measurements for internally isolated fans and motors may be made at the mounting feet.
4. Provide proof of testing agency having successfully completed at least five projects of similar size and scope.
5. Code Compliance: Perform tests in the presence of the Authority Having Jurisdiction (AHJ) where required by the Authority Having Jurisdiction (AHJ).
6. Owner Witness: Perform tests in the presence of the Owners representative.
7. Engineer Witness: The engineer or engineer's representative reserves the right to observe tests or selected tests to assure compliance with the specifications.
8. Simultaneous Testing: Test observations by the Authority Having Jurisdiction (AHJ), the Owner's representative and the engineer's representative need not occur simultaneously.
9. Do not perform testing, adjusting, and balancing work until heating, ventilating, and air conditioning equipment has been completely installed and is operating continuously as required.
10. Conduct air testing and balancing with clean filters in place. Clean strainers prior to performing hydronic testing and balancing.
11. Agent Qualifications: Engage a testing, adjusting, and balancing agent certified by AABC or NEBB.
12. Testing, Adjusting, and Balancing Conference: Meet with the Owner's and the Architect's representatives on approval of the testing, adjusting, and balancing strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of testing, adjusting, and balancing 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) Testing, adjusting, and balancing plan.
 - 4) Work schedule and Project site access requirements.
 - 5) Coordination and cooperation of trades and subcontractors.
 - 6) Coordination of documentation and communication flow.
13. Certification of Testing, Adjusting, and Balancing Reports: Certify the testing, adjusting, and balancing field data reports. This certification includes the following:
 - a. Review field data reports to validate accuracy of data and to prepare certified testing, adjusting, and balancing reports.
 - b. Certify that the testing, adjusting, and balancing team complied with the approved testing, adjusting, and balancing plan and the procedures specified and referenced in this Specification.
 14. Testing, Adjusting, and Balancing Reports: Use standard forms from AABC's "National Standards for Testing, Adjusting, and Balancing."
 15. Testing, Adjusting, and Balancing Reports: Use standard forms from NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems."
 16. Instrumentation Type, Quantity, and Accuracy: As described in AABC national standards.
 17. 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."
 18. Instrumentation Calibration: Calibrate instruments at least every 6 months or more frequently if required by the instrument manufacturer.

1.6 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 testing, adjusting, and balancing Agent fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1) The certified Agent has tested and balanced systems according to the Contract Documents.
 - 2) Systems are balanced to optimum performance capabilities within design and installation limits.

1.7 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 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 Agent: The entity responsible for performing and reporting the testing, adjusting, and balancing procedures.
- N. AABC: Associated Air Balance Council.
- O. AMCA: Air Movement and Control Association.
- P. CTI: Cooling Tower Institute.
- Q. NEBB: National Environmental Balancing Bureau.
- R. SMACNA: Sheet Metal and Air Conditioning Contractors' National Association.

1.8 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 testing, adjusting, and balancing activities.
- B. Notice: Provide 7 days advance notice for each test. Include scheduled test dates and times.
- C. Perform testing, adjusting, and balancing after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 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 testing, adjusting and balancing 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 testing, adjusting, and balancing 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 testing, adjusting, and balancing procedures.
 13. Beginning of work means acceptance of existing conditions.
- D. Preparation:
1. Prepare a testing, adjusting, and balancing 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 testing, adjusting, and balancing operations. Make instruments available to Architect to facilitate spot checks during testing.
- E. General Testing and Balancing Procedures:
1. Perform testing and balancing 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.
 2. 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 Representative, or Commissioning Agent.

3.2 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 (ASHRAE Chapter 35, Table 6):

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	
Less than or equal to 2-inches of water (both positive and negative pressures)	12
Greater than 2 and less than or equal to 10-inches of water (both positive and negative pressures)	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 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 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 representative to witness this procedure.
7. Test duct at 1.5 times the design air pressure. Seal any audible leaks.

3.3 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 plenum ceilings, utilized for supply air, to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- D. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- E. 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.
- F. Prepare schematic diagrams of systems' "as-built" duct layouts.
- G. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- H. 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.
- I. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- J. Verify that motor starters are equipped with thermal protection, sized for the connected load.
- K. Check dampers for proper position to achieve desired airflow path.

- L. Check for airflow blockages.
- M. Check that condensate drains are installed, trapped and primed and routed to drain.
- N. Check for readily observable leaks in air-handling unit components and ductwork.
- O. 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.

3.4 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.

3.5 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.

3.6 KITCHEN AND DISHWASHER HOODS

- A. Determine total airflow into the room where the hood is located and balance systems to ensure adequate air supply to hoods.
 1. Energize the exhaust fan and adjust airflow to provide the indicated hood exhaust air flow rate.
 2. Measure exhaust airflow volume by measuring airflow by Pitot-tube duct traverse.
 3. Record each face velocity measurement taken at 4- to 6-inch increments over the entire hood opening.
 4. Calculate the average face velocity by averaging velocity measurements.
 5. Calculate the airflow volume of exhaust-hood face velocity by multiplying the calculated face velocity by the opening area. Compare this quantity with exhaust volume at exhaust fan and report duct leakage.
 6. Measure airflow volume supplied by makeup fan. Verify that the makeup system supplies the proper amount of air to keep the space at the indicated pressure with the exhaust systems in all operating conditions.
 7. Retest for average face velocity. Adjust hood baffles, fan drives, and other parts of the system to provide the indicated average face velocity and the indicated auxiliary air-supply percentages.
 8. Retest and adjust the systems until fume-hood performance complies with Contract Documents.
 9. For variable volume systems, conduct tests above at full flow conditions, in addition test over entire range of variable flow in 10 percent increments. Test in accordance with variable flow control system manufacturer's recommended test procedures.

3.7 HEAT EXCHANGERS

- A. Adjust water flow to within specified tolerances.
- B. Measure inlet and outlet water temperatures.
- C. Measure inlet steam pressure. Check the setting and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves.
- D. Measure hot and cold side pressure drops.
- E. Record safety valve settings.
- F. Verify operation of steam traps.

3.8 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.

3.9 FINAL REPORTS

- A. Report Requirements:
 1. General:
 - a. 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 testing and balancing 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 Testing, Adjusting, and Balancing 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 Testing, Adjusting, and Balancing 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, packaged rooftop unit air handlers, split systems, fan coils, heat 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. Refrigerant Coils:

1. For refrigerant 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) Refrigerant Expansion Valve and Refrigerant Types
 - 9) Refrigerant Suction Pressure in PSIG
 - 10) Refrigerant Suction 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) Traverse Air Temperature in Degrees F
 - 4) Duct Static Pressure in Inches wg
 - 5) Duct Size in Inches
 - 6) Duct Area in SF
 - 7) Design Airflow Rate in cfm
 - 8) Design Velocity in fpm
 - 9) Actual Airflow Rate in cfm
 - 10) Actual Average Velocity in fpm
 - 11) Barometric Pressure in PSIG
- 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) Preliminary Airflow Rate as Needed in cfm
 - 4) Preliminary Velocity as Needed in fpm
 - 5) Final Airflow Rate in cfm
 - 6) Final Velocity in fpm
 - 7) Space Temperature in Degrees F
- I. Heat Exchangers:
 1. For heat exchangers, include the following:
 - a. Unit Data: Include the following:
 - 1) Unit Identification
 - 2) Location
 - 3) Service
 - 4) Make and Type
 - 5) Model and Serial Numbers
 - 6) Ratings
 - b. Primary Water Test Data: Include design and actual values for the following:
 - 1) Entering-water Temperature in Degrees F
 - 2) Leaving-water Temperature in Degrees F
 - 3) Entering-water Pressure in Feet of Head or PSIG
 - 4) Water Pressure Differential in Feet of Head or PSIG
 - 5) Water Flow Rate in gpm
 - c. Secondary Water Test Data: Include design and actual values for the following:
 - 1) Entering-water Temperature in Degrees F
 - 2) Leaving-water Temperature in Degrees F
 - 3) Entering-water Pressure in Feet of Head or PSIG
 - 4) Water Pressure Differential in Feet of Head or PSIG

5) Water Flow Rate in gpm

J. 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.

3.10 ADDITIONAL TESTS

- A. Within 90 days of completing testing, adjusting, and balancing, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial testing, adjusting, and balancing 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 230700 HVAC INSULATION

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Type A, Flexible Fiberglass Blanket
 - 2. Type B, Duct Liner
 - 3. Type 1, Fiberglass Pipe Insulation
 - 4. Type 2, Flexible Elastomeric Insulation
 - 5. Jacketing
 - 6. Accessories
 - 7. Duct Insulation Accessories
 - 8. Duct Insulation Compounds
 - 9. Outdoor Ducting Cover

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 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.

1.4 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.

1.5 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 to have minimum 5 years experience in the business of installing insulation.

1.6 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.

1.7 FIRE HAZARD CLASSIFICATION

- A. Maximum fire hazard classification of the composite insulation construction as installed to be not more than a flame spread of 25, fuel contributed of 50 and smoke developed 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

2.1 MANUFACTURERS

- A. Type A, Flexible Fiberglass Blanket:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
 - 5. PPG
 - 6. Or approved equivalent.
- B. Type B, Duct Liner:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
 - 5. PPG
 - 6. Or approved equivalent.
- C. Type 1, Fiberglass Pipe Insulation:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Knauf
 - 4. Owens-Corning
 - 5. PPG
 - 6. Or approved equivalent.
- D. Type 2, Flexible Elastomeric Insulation:
 - 1. Glue:
 - a. Armacell LLC Armaflex Low VOC Adhesive
 - b. Halstead
 - c. Or approved equivalent.
 - 2. Paint:
 - a. Armacell LLC Armaflex
 - b. Halstead

- 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. Certainteed
 - 2. Johns Manville
 - 3. Owens-Corning
 - 4. Or approved equivalent.
- H. Duct Insulation Compounds:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Owens-Corning
 - 4. Or approved equivalent.
- I. Outdoor Ducting Cover:
 - 1. Certainteed
 - 2. Johns Manville
 - 3. Owens-Corning
 - 4. Or approved equivalent.

2.2 TYPE A, FLEXIBLE FIBERGLASS BLANKET

- A. ASTM C553, Type 1, Class B-2; flexible blanket.
- B. 'K' Value: $0.27 \text{ BTU} \cdot \text{in} / (\text{hr} \cdot \text{sf} \cdot \text{F})$ at 75 degrees F installed, maximum service temperature: 250 degrees F.
- C. Density: 0.75 pounds per cubic foot.
- D. Vapor Barrier Jacket: FSK aluminum foil reinforced with fiberglass 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.

2.3 TYPE B, DUCT LINER

- A. ASTM C1071; flexible blanket.
- B. 'K' Value: ASTM C518, $0.25 \text{ BTU} \cdot \text{in} / (\text{hr} \cdot \text{sf} \cdot \text{F})$ at 75 degrees F, maximum service temperature: 250 degrees F.
- C. Noise Reduction Coefficient: 0.65 or higher based on "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.

2.4 TYPE 1, FIBERGLASS PIPE INSULATION

- A. Glass Fiber: ASTM C547; rigid molded, noncombustible.
 - 1. Thermal Conductivity Value: As indicated in the insulation tables below.
 - 2. Maximum Service Temperature: 850 degrees F.
 - 3. Vapor Retarder Jacket: White Kraft paper reinforced with glass fiber and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or vapor barrier mastic.

2.5 TYPE 2, FLEXIBLE ELASTOMERIC 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 manufacturers requirements.
- B. Glue: Contact adhesive specifically manufactured for cementing flexible elastomeric foam. Armacell LLC Armaflex Low VOC adhesive, Halstead, or approved equivalent.
- 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. Armacell LLC Armaflex, Halstead, or approved equivalent.

2.6 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.

2.7 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.

2.8 DUCT INSULATION ACCESSORIES

- A. Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

2.9 DUCT INSULATION COMPOUNDS

- A. Cements, adhesives, coatings, sealers, protective finishes and similar accessories as recommended by insulation manufacturer for applications indicated. Comply with South Coast Air Quality Management District (SCAQMD) Rule #1168 in accordance with LEED EQ 4.1.

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 230900 INSTRUMENTATION AND CONTROL PERFORMANCE SPECIFICATIONS

PART 1 GENERAL

1.1 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. Input/Output Interface
 - 9. Power Supplies and Line Filtering
 - 10. Control Panels
 - 11. Auxiliary Control Devices
 - 12. Wiring and Raceways
 - 13. Smoke Detection
- B. This is a performance specification and Contractor is responsible for design tasks and engineering.

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 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).

1.4 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 Representatives return of REVIEWED submittals.

- a. Sequence of Operation: Please note that 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 all 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 all 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 set point.
 - 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 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.
- 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 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.

1.5 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 year's experience in the local area. Installers required to have successfully completed manufacturer's control system factory training.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 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).
- C. 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.
- D. Local Area Network (LAN) either 10 or 100 Mbps Ethernet network.
- E. 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.
 - a. 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.
 - 3. OPC server communications according to OPC Data Access 2.0 and Alarms and Events 1.0.
 - 4. LonTalk protocol.
 - 5. Modbus (RTU/TCP) protocol.
- F. Complete temperature control system to be DDC with electronic sensors and electronic/electric actuation valves and dampers.
- G. 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.
- H. Design, provide, and install equipment cabinets, panels, data communication network infrastructure (including cables, conduits, outlets, connections, etc.) needed, and associated hardware.
- I. Provide complete manufacturer's specifications for items that are supplied. Include vendor name and model number of every item supplied.

- J. Provide a comprehensive operator and technician training program as described in these specifications.
- K. 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.
- L. 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 are solely the responsibility of the BAS Contractor.
- M. Conduit and raceway systems. Install per Division 26, Electrical specifications.
- N. All devices, components, controllers, and software to be manufacturer's most current version at the time of installation.

1.8 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 be annunciated at workstation within 45 seconds.
 - 6. Program Execution Frequency: Custom and standard applications be capable of running as often as once every 5 seconds. Select execution times consistent with mechanical process under control.
 - 7. Performance: Programmable controllers be 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 set point 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

2.1 NORTHERN CALIFORNIA MANUFACTURERS/INSTALLERS

- A. Siemens/Siemens
- B. Johnson Controls/Johnson Controls Bay Metro Office
- C. Invensys/Invensys Systems, Wonderware NorCal, JPR Systems, Inc
- D. Alerton/Syserco Inc
- E. Automated Logic/Sunbelt Controls, Air Systems Inc
- F. Delta Controls/Delta Controls Inc
- G. Reliable Controls/Core Controls Inc, American Mechanical Inc
- H. Andover (Schneider Electric)/Steven Engineering, Alameda Electrical Distributors Inc, Graybar Electric Company Inc, Powermatic Associates
- I. Trane/Trane, Specialty AC Products Inc.
- J. Or approved equivalent.
- K. Duct/Spot-Type Smoke Detectors:
 - 1. See Division 28 for Products.

2.2 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 utilize 2.4 GHz in license free global Industrial Scientific and Medical (ISM) band.
3. Wireless transceiver be encased in plenum-rated enclosure. If application dictates, wireless transceiver be able to be installed in metal enclosure utilizing remote mounted antenna.
4. Wireless transceiver channel be 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 be 24 VAC powered.
6. Wireless transceiver give a visual indication that it is powered and communicating.
7. Wireless transceiver have field settable network identifier that allows multiple networks to occupy same channel for maximum scalability.

2.3 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 be 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) 8 GB of RAM
 - 3) 48x CD-RW/DVD Optical Drive
 - 4) 1 TB Hard Disk Drive Providing Data at 3 GB/sec
 - 5) Ethernet 10/100 Network Interface Card
 - 6) High Performance Graphics Card
 - 7) 22-in LCD Monitor with at least 1024 x 768 Resolution
 - 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 be IBM-compatible notebook-style PC including software and hardware required. PC contains at minimum:
 - a. 1.73 GHz or better Pentium Processor
 - b. 4 GB of RAM
 - c. 500 GB Hard Drive
 - d. Touch-Pad or Other Internal Pointing Device
 - e. High-Performance Graphics Adapter
 - f. Ethernet 10/100 Network Interface Card
 - g. Integrated Wireless 802.11 b/g
 - h. Serial Port and CD/RW-ROM

- i. 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 XP and Windows 7.
2. Dynamic Color Graphics:
 - a. Real-time color graphic displays dynamic and able to update displays.
 - b. Provide operator ability to change values (set points) 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. All 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, be archived on hard disk, and be 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 and all graphics on which object is displayed.
- d. BAS Contractor to enable trending for any and all 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 all 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
 9. Electrical, Gas, and Weather Report:
 - a. System server capable of periodically gathering energy log data stored in the field equipment and archive the information. Archive files appended with new data, allowing data to be accumulated.
 - b. Operator able to change the energy log setup information as well. This includes the meters to be logged, meter pulse value, and the type of energy units to be logged. Meters monitored by the system may be logged.
 - c. System to display archived data in tabular format form for both consumption and peak values. Data shown in hourly, daily, weekly, monthly and yearly formats. In each format the user able to select a specific period of data to view.
 - d. Electrical Meter Report: Provide monthly report showing daily electrical consumption and peak electrical demand with time and date stamp for each building meter and for each electrical sub-meter on individual building panels, circuits, equipment (such as chillers), and variable frequency drives. Provide an annual (12-month) report showing monthly electrical consumption and peak electrical demand with time and date stamp for each individual meter.
 - e. Gas Meter Report: Provide monthly report showing daily natural gas consumption for each meter and sub-meter. Provide annual (12-month) report that shows monthly consumption for each meter.
 - f. Weather Data Report: Provide monthly report showing daily minimum, maximum, and average outdoor air temperature (dry bulb, wet bulb) and humidity. Provide annual (12-month) report showing minimum, maximum, and average outdoor air temperature for month.
- 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.

2.4 CONTROLLER SOFTWARE

- A. Furnish following applications software for building and energy management. Software applications reside and operate in system controllers. All software to be manufacturer's most current version at the time of installation. All 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. Restrict user passwords to objects, applications, and system functions as assigned by system manager. Provide monitoring only access to Engineer of Record and Commissioning Authority for period of one year for trouble shooting purposes.
 - 3. Record user Log On/Log Off attempts.
 - 4. 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.
 - 5. 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 be routed to appropriate workstations based on time and other conditions. An alarm 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.

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 set points 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 all 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 (9e.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 set point. Algorithm direct-acting or reverse-acting and incorporate adjustable differential.
- M. Run-Time Totalization: Provide software to totalize run-times for binary input objects.

2.5 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 and all 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 and all 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.

2.6 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 set points) 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 dampers 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 set points, 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.

2.7 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 Section.
 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 be 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 be 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 be 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.

2.8 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.

2.9 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.

2.10 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.

2.11 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.

2.12 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 set point adjustment on cover with heat anticipator. Thermostat operates within 55 degrees F to 85 degrees F set point range, with 2 degrees F maximum differential.
 - 2. 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 set point adjustment plus or minus 2 degrees F in both directions; LCD temperature display indicating set point only. set point 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.

3. 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.
4. 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.
5. 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. 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 Ration: 0 to 3500 gr/lb
 - 4) Absolute Humidity: 0 to 262 gr/ft^3
 - 5) Wet Bulb Temperature: 32 degrees F to 212 degrees F
9. Manufacturers:
 - a. Vaisala HMP243 with HMK41 field calibrator.
 - b. Or approved Equivalent.

C. 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.

D. 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 be 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.
- E. 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. Pressure Independent Modulating 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. Modulating Control Valves:
 - a. 2-inch and smaller fail-in-place characterized ball valves; ANSI 250 body rating; bronze body and stainless steel trim.
 - b. 2-1/2-inch and larger cast iron ANSI Class 125, Other with guided equal percentage plug; PTFE packing.
 6. Fluid three-way valves globe valves with linear plug with composition disc for tight shutoff.
 7. 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 be line size.
 8. 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
- F. 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. Actuators for emergency generator damper control rated for 350 degree F. maximum operating temperature and capable to drive fully open and close within 15 seconds.
- G. Air Flow Meters:
1. 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.
- H. 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
- I. Carbon Monoxide Detector:
1. Microprocessor based CO sensor and controller with fan relay, pilot light indicators; comply with UL Standards 2034; self-supervision activates fan if system detects problems; calibration kit for project.
 2. Relay to activate fan at sensing 35 ppm CO after 5 minutes. Minimum fan runtime to be 2-1/2 minutes. Relay to activate alarm at sensing 100 ppm CO after 30 minutes. Vulcain Electrochemical Type (Q1).
- J. Nitrogen Dioxide Detector:
1. Microprocessor based NO2 sensor and controller with fan relay, pilot light indicators; comply with UL Standards 2034; self-supervision activates fan if system detects problems; calibration kit for project.
 2. Relay to activate fan at sensing 10 PPM NO2 after 5 minutes. Minimum fan runtime to be 2-1/2 minutes. Relay to activate alarm at sensing 15 PPM NO2 after 30 minutes. Vulcain Electrochemical Type (Q1).
- K. Occupancy Sensor: Dual technology infrared and ultrasonic sensing device, ceiling or wall mounted, built-in self-adjusting settings, timer settings of 30 seconds to 30 minutes, with manual and automatic modes. Provide multiple devices in parallel when area served is greater than a single device sensing capability. Provide integral power pack, 120 VAC input, 24 VDC output, with manual override switch. Leviton OSC-MOW series.
- L. 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.
- M. Relays:

1. Control relays UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage 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 set point or as indicated. Contact rating, configuration, and coil voltage be suitable for application. Provide NEMA 1 enclosure when not installed in local control panel.
- N. 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.
- O. Current Transmitters:
1. AC current transmitters be 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 ranges 10 A full scale, 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.
- P. 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.
- Q. 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.
- R. 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.
- S. 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.
- T. Overflow Switch: Insertion flow sensor, brass, impeller flow design with analog transmitter unit. Data Industrial Model 220BR.
- U. 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.
- V. 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 dependant on dew point, humidity, or temperature determinations.
 5. Specifications (Based on Condensor):
 - a. Mounting:
 - 1) The Model C CONDENSOR 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 CONSENSOR 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.

2.13 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. Field panels and controllers to be supplied by building emergency power system where systems being monitored or controlled are on emergency power.
- D. 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.
- E. Field and Subfield Panels: Voltage in panels not-to-exceed 120 volts.
- F. 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.
- G. 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.

2.14 SMOKE DETECTION

- A. See Division 28 for Products.

PART 3 EXECUTION

3.1 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 Owners' 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.

3.2 CONTROL SYSTEM CHECKOUT AND TESTING

- A. Testing completed before Owner's 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.

3.3 ACCEPTANCE TESTING AND TRAINING

- A. Site Testing:
 - 1. Contractor provides personnel, equipment, instrumentation, and supplies necessary to perform testing. Owner or Owner's 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 3 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 representative at least 15 days prior to training.
 - 2. Operator's Training I: First course taught at supplier's facility for period of two consecutive training days. 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.

3.4 WIRING

- 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, AD, DO, and function (i.e. pump start, OM Sensor.)

3.5 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."

3.6 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 standout 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.

3. Pneumatic Actuators:

- a. Size pneumatic damper actuator to operate related control damper(s) with sufficient reserve power to provide smooth modulating action or two-position action. Actuator also sized for proper speed of response at velocity and pressure conditions to which control damper is subject.
- b. Pneumatic damper actuators produce sufficient torque to close off against maximum system pressures encountered.
- c. Where two or more pneumatic damper actuators are installed for interrelated operation in unison, provide dampers with positive pilot positioner. Positive pilot positioner directly mounted to pneumatic damper actuator and have pressure gauges for supply input and output pressures.
- d. Total damper area operated by actuator not-to-exceed manufacturer's maximum area rating. Provide at least one actuator for each damper Section. Each damper actuator not to power more than 20-feet of damper.
- e. Use line shafting or shaft couplings (jackshafting) in lieu of blade-to-blade linkages or shaft coupling when driving axially aligned damper Sections.

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 all 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 60-70 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 all 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 2½-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.

3.7 SMOKE DETECTION

- 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 supply 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.

END OF SECTION

SECTION 230913 VARIABLE FREQUENCY DRIVES

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Variable Frequency Drive
 - 2. Protection Circuits
 - 3. Display and Control Interface
 - 4. Adjustments

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 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 IEEE Standard 519, Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
 - 2. Current edition of UL 508, Industrial Control Equipment.
 - 3. Current edition of NEMA ICS 7, Industrial Control and Systems: Adjustable-Speed Drives; National Electrical Manufacturers Association, latest edition.
 - 4. Current edition of IEC 16800 parts 1, 2 and 3
 - 5. Current edition of NEC 430.120, Adjustable-Speed Drive Systems.

1.4 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: Indicate voltage, controller size, ratings and size of switching and overcurrent protection devices, short circuit ratings, dimensions, weights and enclosure details.
 - 2. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and name plate legends.
 - 3. Test Reports: Subject VFD to preliminary functional test, and final test at 104 degrees F, at full rated load. Indicate field test and inspection procedures and test results.
 - 4. Manufacturer's Instructions: Include installation instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
 - 5. Maintenance Data: Include routine preventive maintenance schedule.
 - 6. Compliance to IEEE 519, harmonic analysis for particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
 - a. Manufacturer to provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5 percent. VFD's to include a minimum of 5 percent impedance reactors, no exceptions.
 - 7. Rated input: Maximum electric load rating in amperes.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, meet following:
 - 1. Qualifications:
 - a. Provide VFDs and options UL listed as a complete assembly. Base VFD UL listed for 100 KAIC without the need for input fuses.
 - b. CE Mark: VFD to meet product standard EN 61800-3 for the First Environment restricted level. (RFI/EMI Filter specification.)
 - c. Entire VFD enclosure, including the bypass, seismically certified and labeled in accordance with the International Building Code:
 - 1) VFD manufacturer to provide Seismic Certification and Installation requirements at time of submittal.
 - 2) Seismic importance factor of 1.5 rating is required, and based upon actual shake test data as defined by International Code Council AC-156.
 - 3) Seismic ratings based upon calculations alone are not acceptable. Certification of Seismic rating must be based on testing done in all three axis of motion by a certified lab.

1.6 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

2.1 MANUFACTURERS

- A. ABB
- B. Allen Bradley
- C. Cerus
- D. Danfoss
- E. Emerson
- F. General Electric
- G. Siemens
- H. Schneider Electric/Square D
- I. Toshiba
- J. Trane
- K. Yaskawa
- L. Or approved equivalent.

2.2 VARIABLE FREQUENCY DRIVE

- A. Description:
 - 1. Variable Frequency Drive: Solid state, with Pulse Width Modulated (PWM) output waveform in a UL listed enclosure (enclosures with only NEMA ratings are not acceptable), completely assembled and tested by manufacturer. Employ full wave rectifier, AC or DC Line Reactor, capacitors, and Insulated Gate Bipolar Transistors (IGBTs) as output switching device.

2. Enclosure: UL rated and UL listed as a plenum rated VFD with NEMA 1 enclosure (indoors), NEMA 3R (outdoors), NEMA 12 (for indoor dusty locations), NEMA 8 (hazardous, Class I, Div I) and NEMA 9 (Class II, Div I). Manufacturers standard enamel.
 3. Drive manufacturer to supply the drive and necessary options specified. VFD's that are manufactured by a third party and "brand labeled" are not acceptable. Provide VFD's installed on this project from the same manufacturer.
- B. Operating Requirements:
1. Rated Input Voltage: VAC as scheduled on drawings, plus or minus 10 percent, 3 phase, 48 to 63 Hz.
 2. Rated Output Voltage: 0 to input voltage, 3 phase, 0 to 120 Hz.
 3. Fundamental Power Factor: Between 1.0 and 0.97, lagging, over entire range of operating speed and load.
 4. Minimum Efficiency at Full Speed and Full Load: 97 percent or better.
 5. Volts Per Hertz Adjustment: Plus or minus 10 percent.
 6. Current Adjustment: 60 to 110 percent or rated.
 7. Acceleration Rate Adjustment: 0.5 to 300 seconds.
 8. Deceleration Rate Adjustment: 1 to 300 seconds.
 9. Transient protection against normal transients and surges in incoming power line.
 10. Environmental Conditions: 32 degrees F to 104 degrees F at 4kHz switching frequency, 0 to 3000-feet above sea level, less than 95 percent RH, noncondensing. Circuit boards to have conformal coating.
 11. Seismic Testing: Tested to ICC AS-156. Submit certificate of compliance.
- C. Standard Features:
1. VFD's to have the same customer interface, including digital display, and keypad, regardless of horsepower rating. Provide removable keypad, capable of remote mounting and allow for uploading and downloading of parameter settings as an aid for start-up of multiple VFD's.
 2. Fault Mode on Loss of Input:
 - a. Display fault.
 - b. Run at programmable preset speed as selected by user.
 3. Utilize English digital display (code numbers are not acceptable). Digital Display: Three configurable lines of LCD display, backlit, adjustable contrast. Setup parameters, indications, faults, warnings, status indicators and other information in words without use of manual or cross reference table.
 4. Automatic restart after overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. Programmable number of restart attempts, trial time, and time between reset attempts.
 5. Capable of starting into rotating load (forward or reverse) and accelerate or decelerate to setpoint without safety tripping or component damage (flying start).
 6. Automatic extended power loss ride-through circuit.
 7. Customer terminal strip isolated from line and ground.
 8. Keypad Hand-Off-Auto switch. When in "Off" VFD will be stopped. When in "Auto" VFD will start via external contact closure and its speed will be controlled via external speed reference. When in "Hand" VFD will be controlled via keypad up and down arrows.
 9. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.
 10. Input Line Reactor: Five percent impedance AC or DC, to reduce harmonics to power line and to add protection from AC line transients.
 11. Output filters for VFD's located more than 350 conductor feet from motor served.
 12. Optimized for 4 kHz carrier frequency to reduce motor noise.
 13. Bypass Controller:

- a. A complete factory wired and tested bypass system consisting of a door interlocked, padlockable circuit breaker, output contactor, bypass contactor, and fast acting VFD isolation fuses.
 - b. The bypass enclosure door and VFD enclosure must be mechanically interlocked such that the disconnecting device must be in the "Off" position before either enclosure may be accessed.
 - c. VFD and bypass package to have a UL listed short circuit current rating (SCCR) of 100,000 amps and indicated on the UL data label.
 - d. Drive Isolation Fuses: Provide fast acting fuses, exclusive to the VFD, to allow the VFD to disconnect from the line prior to clearing upstream branch circuit protection. Bypass designs, which have no such fuses will not be accepted.
 - e. The system (VFD and Bypass) tolerated voltage window to allow the system to operate from a line of +30 percent, -35 percent nominal voltage range. The system to incorporate circuitry that will allow the drive or bypass contactor to remain "sealed in" over this voltage tolerance at a minimum.
 - f. The bypass to maintain positive contactor control throughout the voltage tolerance window of nominal voltage +30 percent, -35 percent. Designs that will not allow input single phase operation in the VFD mode are not acceptable.
 - g. Motor protection from single phase power conditions - the bypass system must be able to detect a single phase input power condition while running in bypass, disengage the motor in a controlled fashion, and give a single phase input power indication. Bypass systems not incorporating single phase protection in bypass mode are not acceptable.
 - h. Bypass system will NOT depend on the VFD for bypass operation. Bypass system designed for stand alone operation and completely functional in both Hand and Automatic modes even if the VFD has been removed from the system for repair/replacement. Serial communications to remain functional even with the VFD removed.
 - i. Serial communications: Provide bypass capable of being monitored and / or controlled via serial communications. On-board communications protocols to include ModBus, Johnson Controls N2, Siemens Building Technologies FLN (P1), LonWorks and BACnet MS/TP.
 - j. Bypass control to include a programmable time delay for bypass start and keypad indication that this time delay is in process. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates at full speed in the bypass mode. Time delay field programmable from 0 - 120 seconds.
 - k. Provide user selectable text to be displayed on the keypad when an external safety opens. Example text display indications include "FireStat," "FreezStat," "Over Pressure" and "Low Suction". User to have ability to determine which of the up to four customer safety contacts is open over the serial communications connection.
 - l. Smoke Control Override Mode (Override 1): Bypass to include a dedicated digital input that will transfer motor from VFD mode to bypass mode upon receipt of a dry contact closure from the Fire/Smoke Control System. In this mode, the system will ignore low priority safeties and acknowledge high priority safeties as required by UL 864/UUKL. Keypad control, serial communications control, and normal customer start/stop control inputs will be disregarded. This Smoke Control Mode designed to meet the intent of UL864/UUKL.
 - m. Fireman's Override Mode (Override 2): Bypass to include a second, programmable override input which will allow the user to configure the unit to acknowledge selectable digital inputs. This programmability allows the user to program the bypass unit to react in whatever manner the local Authority Having Jurisdiction (AHJ) requires. The Override 2 action may be programmed for "Run-to-Destruction." The user may also force the unit into Override 2 via the serial communications link.
14. Disconnecting Means: Include door interlocked, UL 508C listed circuit breaker or fused disconnect switch.
15. Control circuit transformer with fused primary and secondary circuits.
16. Motor overload protection: Fused disconnects for each motor when serving multiple motors from one drive.

17. Input current rating of the VFD to be no more than 3 percent greater than the output current rating. VFD's with higher input current ratings require the upstream wiring, protection devices, and source transformers to be oversized per NEC 430.120.
18. VFD to provide a programmable loss-of-load (broken belt/broken coupling) Form-C relay output. Provide programmable drive to signal the loss-of-load condition via a keypad warning, Form-C relay output, and / or over the serial communications bus.

2.3 PROTECTION CIRCUITS

- A. Overload Rating: 110 percent of its variable torque current rating for 1 minute every 10 minutes at 104 degrees F, and 140 percent of its H torque current rating for 2 seconds every 15 seconds.
- B. 350 percent instantaneous overcurrent trip.
- C. 130 percent to 65 percent over and under voltage trip.
- D. Over temperature trip at 115 degrees F.
- E. Short circuit protection, either running or at start, for phase to phase and phase to ground faults, phase rotation insensitive.
- F. Adaptable Electronic Motor Overload (I_{2t}).
- G. EMI/RFI Filters: VFD's to include EMI/RFI filters. Onboard filters to allow the entire VFD assembly to be CE Marked and the VFD to meet product standard EN 61800-3 for the First Environment restricted. No Exceptions.
- H. Orderly Shutdown: In event of any of above conditions, shutdown drive safely without component failure.

2.4 DISPLAY AND CONTROL INTERFACE

- A. Serial Communications:
 1. VFD to have an EIA-485 port as standard. Standard protocols: Modbus, Johnson Controls N2, Siemens Building Technologies FLN, and BACnet MS/TP. The use of third party gateways and multiplexers is not acceptable. Protocols "certified" by the governing authority (i.e. BTL Listing for BACnet).
- B. Display operating information at VFD and provide separate interface signal for Building Automation System (BAS) via communications port to display and control following:
 1. Frequency Output - Hz
 2. Output voltage - Volts
 3. Current - Amps
 4. Speed - RPM
 5. Runtime - Hours
 6. System Fault
 7. Input Speed Setpoint - RPM
 8. On/Off Control Signal
 9. Calculated Motor Power - percentage or kW
 10. kWh meter

2.5 ADJUSTMENTS

- A. Three programmable critical frequency lockout ranges.
- B. Two programmable analog inputs. Analog inputs to include filters programmable from 0.01 to 10 seconds to remove any oscillation in input signal.
- C. Six programmable digital inputs for maximum flexibility in interfacing with external devices.
- D. Three remote contacts for fault including on/off status, fault and future configuration.

- E. Two programmable analog outputs proportional to frequency, motor speed, output voltage, output current, or scalable parameter selected by Owner.
- F. Run permissive circuit: Provide a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad command, input contact closure, time-clock control, or serial communications), the VFD to provide a dry contact closure that will signal the damper to open (VFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) to close. The closed end-switch is wired to a VFD digital input and allows VFD motor operation. Provide a minimum of two separate safety interlock inputs. When any safety is opened, the motor commanded to coast to stop and the damper commanded to close.
- G. The VFD control to include a programmable time delay for VFD start and a keypad indication that this time delay is active. A Form C relay output provides a contact closure to signal the VAV boxes open. This will allow VAV boxes to be driven open before the motor operates.
- H. The VFD to include a fireman's override input. Mode to override other inputs (analog/digital, serial communication, and keypad commands), except customer defined safety run interlocks, and force the motor to run at a preset speed or in a separate PID mode.

END OF SECTION

SECTION 230933
ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Room Thermostats
 - 2. Smoke Detection
 - 3. Relays and Contactors
 - 4. Transformers
 - 5. Wiring
 - 6. Carbon Dioxide Sensors
 - 7. Damper Operators
 - 8. Motorized Control Valves
 - 9. Electric Valve Actuators

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.
- B. In addition, reference the following:
 - 1. Power wiring per Division 26, Electrical.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Drawings: complete control diagram, including written description of control sequences.
 - 2. Operation and Maintenance Manual: Include record wiring drawings showing installed condition and operating changes made during start-up.

1.5 QUALITY ASSURANCE

- A. Quality assurance as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.6 WARRANTY

- A. Warranty of materials and workmanship as outlined in Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.
- B. In addition, provide:
 - 1. Within 30 days prior to warranty expiration date, control supplier to visit job site and check calibration, operation, and adjustment of temperature, pressure and humidity sensors, valves, dampers, thermostats and other devices installed by control supplier. Make repair or replacement of defective control equipment as required at no charge to Owner.
 - 2. Submit letter to Architect certifying that this work has been completed.
 - 3. Attach copy of service report signed by Owner's Representative.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Room Thermostats:
 - 1. Honeywell
 - 2. Siemens
 - 3. Johnson Controls
 - 4. Reliable Controls
 - 5. Alerton
 - 6. Or approved equivalent.
- B. Duct/Spot-Type Smoke Detectors
 - 1. See Division 28 for Products.
- C. Carbon Dioxide Sensor:
 - 1. Honeywell
 - 2. Or approved equivalent.
- D. Damper Operators:
 - 1. Belimo
 - 2. Honeywell
 - 3. Siemens
 - 4. Or approved equivalent.
- E. Motorized Control Valves:
 - 1. Honeywell
 - 2. Siemens
 - 3. Johnson Controls
 - 4. Or approved equivalent.
- F. Electric Valve Actuators:
 - 1. Belimo
 - 2. Honeywell
 - 3. Siemens
 - 4. Or approved equivalent.

2.2 ROOM THERMOSTATS

- A. Electric Thermostat: Wall mounted thermostat with heat anticipation, automatic changeover and standard Fahrenheit slide switch with thermometer 1 stage heat, 2 stage cooling. Heat/auto/cool and continuous fan switch. Basis of Design: Honeywell Econostat.
- B. Line Voltage, Cooling Thermostat: Wall mounted thermostat, non-programmable, dial adjustment between 44 degrees F and 86 degrees F, gold color. Basis of Design: Honeywell T65.
- C. Electronic BACnet Thermostat/Controller: Wall mounted, 24 VAC, LED display, up to three universal inputs, up to four outputs, dedicated temperature sensor, up to four pre-programmed control strategies.

2.3 SMOKE DETECTION

- A. See Division 28 for Products.

2.4 RELAYS AND CONTACTORS

- A. Provide relays and contactors where required or as shown on Drawing to meet operating sequence where not internal to manufacturer's equipment.
- B. Furnish relays or contactors with required coil voltage and contact amperage rating for use specified on Drawing and in manufacturer's equipment.
- C. Mount relays in single control cabinet with hinge door and latch.
- D. Control cabinet contains relays and numbered terminal strips for connection of relays and field wiring. Mount cabinet on painted plywood panel securely attached to wall framing. Mount time clock, transformer and motor contactors (if required) on plywood adjacent to control panel.

2.5 TRANSFORMERS

- A. Transformers selected and sized for appropriate VAC capacity and installed and fused according to applicable codes. Provide wiring to nearest suitable power source as required.

2.6 WIRING

- A. In accordance with Division 26, Electrical and applicable codes.
- B. Provide line and low voltage wiring relating to control system. Includes wiring of contactors, relays, circuits, and incidental power wiring: operation power for time clock, power when run through stat/timeclock/relay, transformers.

2.7 CARBON DIOXIDE SENSORS

- A. General: Return-mounted carbon dioxide sensor.
- B. Range and Accuracy: 0 to 2,000 PPM plus or minus 50 PPM. Maximum drift of plus or minus 50 PPM per year.
- C. Output Signal: 4 to 20 milliamp linearized.
- D. Calibration interval: 5 years.
- E. Ambient Operating Conditions: 32F to 122F.
- F. Basis of Design: Honeywell IAQ Point.

2.8 DAMPER OPERATORS

- A. Size operators to operate dampers properly against system pressures, pressure differentials and velocities. Damper operators sized for 150 percent of damper forces normally encountered. Spring return closed for outside air applications.

2.9 MOTORIZED CONTROL VALVES

- A. Body pressure rating and connection type construction conforms to pipe, fitting and valve schedules.
- B. Fluid valve close-off ratings and spring ranges operates at maximum flows and maximum available pump heads scheduled without leakage.
- C. Screwed ends except 2-1/2-inch and larger valves with flanged ends.
- D. Fluid two-way modulating valves:
 - 1. 2-inches and smaller pressure independent valves as specified in 23 21 13.
 - 2. 2-1/2-inches and larger pressure independent Delta P valves as specified in Section 23 21 13.
- E. Fluid three-way valves globe valves with linear plug with composition disc for tight shutoff.

- F. 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 be line size.
- G. 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

2.10 ELECTRIC VALVE ACTUATORS

- A. Provide mechanical or electronic stall protection for each actuator.
- B. 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.
- C. 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.
- D. Actuator sized for torque required plus 25 percent; UL or CSA listed; electronic current overload protection.
- E. Actuators for emergency generator damper control rated for 350 degree F. maximum operating temperature and capable to drive fully open and close within 15 seconds.

END OF SECTION

SECTION 231113 FACILITY FUEL - OIL PIPING AND SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Pipe and Pipe Fittings
 - 2. Valves
 - 3. Underground Storage Tank System (UST)
 - 4. Leak Detection System for Underground Storage Tanks
 - 5. Fuel-Oil Fill Ports
- B. Provide labor for installation of Fuel management System (FMS), including but not limited to: raceway, control wiring and programming as required for FMS to interface with fuel system controls. Provide control wiring per FMS shop drawings and in compliance with the locally adopted version of the National Electric Code and Division 26, Electrical material and installation requirements.
- C. Contractor to coordinate and provide all interconnecting piping, conduits, fittings, etc., between suppliers equipment and devices for complete and operating system.

1.2 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 26, Electrical requirements for grounding fuel piping systems.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 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. Qualifications: Firms with a minimum of 5 years experience and regularly engaged in manufacture and/or installation of fuel-oil burning equipment and fuel-oil system products of types, materials, and sizes required.
 - 2. Provide complete fuel oil handling and dispensing systems including the pump set(s), control cabinet(s), tank, tank gauging, disposers, and accessories supplied by one Original Equipment Manufacturer (OEM). OEM has employees who manufacture, design, start up and service fuel oil handling systems of this nature throughout the United States. Proof of manufacturing and starting up of the specified system(s) within the last 5 years must be supplied. This is to assure the highest standards of product quality and system integration capabilities for the customer.
 - 3. Comply with the current edition of the following regulatory requirements as well as all References and Standard specified in Section 23 00 00, HVAC Basic Requirements :
 - a. NFPA Compliance: Install fuel systems in accordance with:

- 1) NFPA 31, Standard for the Installation of Oil Burning Equipment.
- 2) NFPA 30, Flammable and Combustible Liquids Code.
- b. UL Compliance:
 - 1) UL 567, Pipe Connectors for Flammable and Combustible Liquids and LP Gas.
 - 2) UL 79, Power Operated Pumps for Petroleum Product dispensing Systems.
 - 3) UL 971, Standard for Nonmetallic Underground Piping for Flammable Liquids.
 - 4) UL 842, Standard for Safety for Valves for Flammable Fluids.
 - 5) UL 2085, Standard for Fire Resistance of Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - 6) UL 142, Standard for Steel Aboveground Tanks for Flammable and Combustible Liquids.
 - 7) UL 508, Standard for Safety of Industrial Control Equipment.
- c. FM Global Compliance:
 - 1) Provide fuel-oil system products that are listed by FM Global as acceptable.
 - 2) FM Global Property Loss Prevention Data Sheet 7-88, "Storage Tanks for Flammable and Combustible Liquids."
4. Submit a complete, project-specific submittal package containing scale drawings of piping layout and components, complete bill of materials, control cabinet layouts, sequence of operations, electrical wiring diagrams, catalog data and proof of product liability insurance. Partial submittals not accepted. Drawings and product information are to be project specific. Catalog cuts or "standard drawings" not acceptable.
5. Product Data: Submit manufacturer's technical product data and installation instructions for fuel system materials and products, instrumentation, and leak detection systems.
 - a. Provide submittals for piping, safety devices, storage tanks, cathodic protection products, fill ports, day tanks, and any other products required to provide complete working system together with their listed regulatory compliance.
 - b. List regulatory compliance of submitted products to applicable construction standards.
 - c. Submit copies of product warranties applicable to products specified in this Section.
 - d. Submit manufacturer's shop drawings for storage tanks either above or below grade applications. Include dimensions and locations of fittings and accessories, including manways, ladders, heating coils, and emergency relief vents. Indicate locations for related electrical equipment, control panels, and electrical enclosures. Include corrosion protective product coatings and cathodic protection systems for below grade applications.
 - e. Provide submittals for electrical products required to provide complete working system together with their listed regulatory compliance. Products provided will be suitable for installation in hazardous locations as defined by NFPA 70, National Electrical Code. Provide electrical enclosures with NEMA ratings appropriate for their installed use.
 - f. Show in shop drawings how fuel oil system controls interface with Fuel Management System, including but not limited to: Pump and valve control, annunciation of alarm conditions, etc. Include sequence of operation for fuel oil system as part of overall submittal.
 - g. Submit shop drawings and calculations for support and seismic bracing of above grade storage tanks. Seismic support calculations to be wet-stamped and signed by licensed structural engineer specifically for project's storage tank.
 - h. Submit shop drawings and buoyancy calculations for support and anchoring of below grade storage tanks. Support and buoyancy calculations to be wet-stamped and signed by licensed structural engineer specifically for project's storage tank.
6. Record Drawings: At project closeout, submit Record Drawings of installed piping, oil storage tanks, and fuel systems products. Below grade installed products to include invert elevations for piping and storage tank.
7. Maintenance Data: Submit maintenance data and parts list for fuel systems materials and products. Include this data, product data, shop drawings and Record Drawings in maintenance manual.
8. Substitutions: Where items of equipment and/or materials are specifically identified by a manufacturer's name or model number, such specified items may be used in the base bid. If

the Contractor wishes to utilize equipment other than that specifically named in the base bid, they must submit a request in writing, together with the full description and technical data on the equipment proposed as listed in Division 01, General Requirements for substitutions. If such equipment is accepted as an alternate, bidders will be notified to allow them to include the accepted equipment. It is further understood that the substitution(s) are to include modifications or extra cost(s), regardless of the trade(s) involved, or changed necessary due to the alternate equipment. Submittal or shop drawings, if other than the base named equipment, must show detailed changes required by other trades involved. Contractor is responsible for additional costs involved. Under no circumstances are the Architect or Engineer responsible for the installation, operation, or performance of substitute materials or equipment, even though accepted; this is the sole responsibility of the Contractor. In addition to specific warranty in the heating, ventilating, air conditioning, plumbing, or electrical Specifications, the manufacturers of equipment to be supplied under any substitution warrant the same against costs, including labor and material, arising out of defects in material and/or workmanship, for a period coextensive with the guarantee period provided in the Contract Documents.

9. The calculation of capacities, quantities, dimensions, and other attributes are based on the pertinent data of the Base Name Manufacturers. If submitted alternate manufacturer is accepted as an alternate, it is the Contractor's responsibility to investigate in detail the products of these other manufacturers. The Contractor is solely responsible for changes in design, location, dimension, function, and installation involved in selection of other than the Base Named Manufacturer. The contractor is responsible for, and bears costs for, changes including required work of other trades, or the Owner and including the Architects and Engineer's redesign or evaluation of submittal costs caused directly or indirectly by the use of equipment other than that listed on the Drawings or called for in the Specifications.
10. Factory Testing:
 - a. Prior to shipment, manufacturer tests "packaged" assemblies. Owner and/or consulting engineer at their discretion to observe this and other tests.
 - b. Electrical components functionally tested with instruments and controls. Settings of instruments and controls verified for conformance to these Specifications. A certificate of factory testing, together with a copy of the wiring diagram to be placed in the control cabinet prior to shipment. Affix UL-508 label to the inside of the cabinet.
 - c. Test pump sets fully prior to shipment. Testing includes both a pressure and vacuum testing period. First, the complete pump set is pressure tested to rated pressure using an air pressure source. The test confirms that the pump set piping system can maintain rated pressure for 4 hours. Next, the complete pump set is brought to a vacuum greater than 25"Hg. The test confirms that the pump set piping system can maintain vacuum for 4 hours. Following a pressure and vacuum test, the pump set is given a full operational test. The pump set is connected to a fuel oil supply and return. The pump set is operated normally. Motor amps noted at no load and full load for each motor. The motor amps within 10 percent of rated motor amps. During the test, the relief valve is set and tested. Operation of pump set instrumentation is tested.
 - d. Fuel oil storage tank hydrostatic testing is required to ensure tightness prior to shipment. The minimum pressure for testing the tank is 5 PSI. The hydrostatic pressure is maintained until joints and connections have been visually inspected for leaks, but in no case for less than one-half hour. The tank shows no permanent deformation as a result of the test. The rupture basin (open top) is hydro tested prior to shipment. The basin maintains a full water level while joints and connections are visually inspected for leaks. Run test for no less than one-half hour.
11. Installation, Startup, Training and Service:
 - a. Installation in strict accordance with manufacturer's instructions.
 - b. The Contractor provides the services of the manufacturer's technician to monitor the installation, start-up, test and calibrate the equipment. The manufacturer's technician also provides training. The fuel handling system as a whole is functionally tested. Instrument settings verified for conformance to these Specifications.
 - c. Provide factory certified service for the startup and certification of the fuel oil handling system and Fuel Management System (FMS). Provide for one 8-hour training session in the proper operation and maintenance of the equipment. Training sessions cover the

operation, troubleshooting and maintenance of the fuel-handling equipment and FMS. Installing contractor will not waive this requirement. Provide a letter from the fuel oil handling system manufacturer and FMS manufacturer to the consulting engineer and Owner stating that the system received its factory startup and that components are in working order.

- d. Training session for the fuel oil handling system to include its integration with the FMS. Provide training on same day as FMS training, unless otherwise directed by Owner.

1.6 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

2.1 PIPE AND PIPE FITTINGS

- A. Steel Pipe (Above Grade Installations and in containment vessels or etc.) : ASTM A53, electric-resistance welded (Type E) or seamless (Type S), Grade B, black, Schedule 40 pipe, manufactured for threaded or welded pipe connections.
- B. Fittings for Steel Pipe (Above Grade Installations):
 - 1. General: Mark fittings, unions, and other products recognized as regularly available products in accordance with MSS SP-25. Marking on products of small size or shape may be omitted in sequence allowed by MSS SP-25, except for manufacturer's name or trademark.
 - 2. Threaded Fittings: Conforming to ANSI B2.1, ASTM A47, 150 PSI rating, except where otherwise specified, or prevailing codes or requirements dictate use of 300 PSI ratings. Fittings to be fabricated from standard malleable iron with dimensions conforming to ANSI B16.3.
 - 3. Welded Fittings: Wrought carbon steel fittings, ASTM A234, ANSI B16.9, B16.28. Butt-welding type unless otherwise indicated to be socket welding type.
 - 4. Flanges: Carbon steel conforming to ASTM A105, ANSI B16.5, and factory forged in USA. Flanges which have been machined, remade, painted, or are non-domestic origin are not acceptable. Provide raised or full face ends wherever indicated or required.
 - 5. Flange Gaskets: Gaskets to be constructed from Buna-N (Nitrile), NBR, or Viton elastomeric materials.
 - 6. Flange Hardware: Bolting materials to be corrosion resistant carbon steel bolts and hex nuts conforming to ASTM A307. Bolting materials used in containment sumps below grade applications be stainless steel bolts and hex nuts conforming to ASTM A453. Threads and dimensions to be in accordance with ANSI B1.1 and B18.2.
 - 7. Unions: Conform to ANSI B16.39, ASTM A47 and fabricated from malleable iron with bronze-to-iron ground joints rated at 150 percent design operating pressure. Threads to conform to ANSI B2.1.
 - 8. Threaded Pipe Plugs: Conforming to ANSI B16.14.
 - 9. Thread Lubricant: Meet or exceed AGA No. 4-90 rating and compliant with Federal Specification TT-S-1732, manufactured compatible with fuel oil.
- C. Steel Pipe - Double Wall (Below Grade Installations/Exposed Areas):
 - 1. Carrier Piping: ASTM A53, steel pipe, ERW or seamless, Grade F, black, Schedule 40, welded connections.
 - 2. Secondary Containment Piping: ASTM A135, steel pipe, ERW or seamless, Grade B, black, Schedule 10, welded. Provide epoxy or other suitable corrosion resistant coating on exterior surfaces, minimum 30 mil. Provide tinker test after complete installation to check for pipe "holidays." Both supply and return piping in single containment pipe. Seal annular space on ends with steel plate with 1- inch ball valve drain.

3. Leak Detection: Provide leak detection cable for diesel fuel continuous, throughout underground piping system. Provide leak detection system control panels and appurtenances for complete working system.
 4. Secondary Containment Pipe Fittings: Constructed of same materials as containment piping. Provide exposed welds with corrosion resistant material and tinker tested for "holidays." Fittings capable of accepting leak detection cable without splices.
 5. Based On: Con II steel/steel containment piping as manufactured by Thermacor, Inc.
- D. Steel/Fiberglass - Double Wall (Below Grade Piping, Double-Wall Installation with Continuous Sleeve Monitoring):
1. Carrier Piping: ASTM A53, steel pipe, ERW or seamless, Grade F, black, Schedule 40, welded connections.
 2. Containment Piping: ASTM A135, steel pipe, ERW or seamless, Grade B, black, Schedule 10, welded. Provide epoxy or other suitable corrosion-resistant coating on exterior surfaces, minimum 30 mil. Provide tinker test after complete installation to check for pipe "holidays." Both supply and return piping in single containment pipe. Seal annular space on ends with steel plate with 1-inch ball valve drain.
 3. Leak Detection: Provide leak detection cable for diesel fuel continuous, throughout underground piping system.
 4. Double Containment Pipe Fittings: Constructed of same materials as connecting piping. Provide exposed welds with corrosion resistant material and tinker tested for "holidays." Fittings capable of accepting leak detection cable without splices
 5. Secondary containment piping engineered double-pipe Type FS containment system. Protect supply and/or return carrier pipes from the exterior environment by one secondary containment. System supplier with at least five years of experience in the manufacture of secondary contained pipe systems. Straight Sections, fittings and other accessories factory prefabricated and designed to minimize the number of field connections. Underground piping must be submitted for review by the Engineer.
- E. Steel/Fiberglass - Double Wall Pipe (Below grade Piping, Double-Wall Installations)
1. Carrier Pipe: Carbon steel carrier pipe supply and return of standard weight carbon steel, ASTM A-53 Grade B ERW or seamless. Joints butt welded for sizes 2-1/2-inches and greater, and socket or butt welded for 2-inches and below. Where possible, straight Sections supplied in 40-foot random lengths with 6-inches of piping exposed at each end for field joint fabrication.
 2. Secondary Containment: Multi layered composite fiberglass-reinforced thermosetting resin pipe, made in accordance with ASTM D2996 and D2310, comprised of a two-part corrosion barrier not less than 45 mils thick and a filament-wound structural wall. The glass-to-resin ratio for the inner surface, corrosion barrier and structural will not be greater than 20:80, 30:70, and 70:30 respectively. Outer layer contains 0.2 to 0.3 percent by weight of ultraviolet inhibitors for protection during outdoor storage.
- F. Pipe Supports:
1. Support spacing determined by the manufacturer based on pipe diameter, pipe materials, and operating temperature of the product pipes. Pipes within the secondary containment to be supported at not more than 10-foot intervals. Supports of the same material as the carrier pipes and designed to allow for continuous airflow and drainage of the secondary containment in place.
- G. End Seals:
1. End seals and other sub assemblies designed and factory prefabricated to prevent the ingress of moisture into the system. Sub assemblies designed to allow for complete draining of the secondary containment.
- H. Field Closure:
1. The field closure made with a split fiberglass closure sleeve of the same diameter and thickness as the containment pipe. Sleeve sealed and bonded to the containment pipe with double hand lay-ups over seams.

I. Flexible Piping (Below grade Installations):

1. UL 971, double wall piping designed for direct burial installations or installation in corrugated flexible conduit manufactured from high-density polyethylene. Designed for transfer of flammable liquids from underground storage tanks. Piping may also be used for vapor recovery, tank venting, or marina applications. Environ®, Geoflex-D Double Wall Piping.
2. Flexible Conduit: 4-inch, corrugated flexible conduit made for use with Geoflex-D Double Wall Piping. Use of conduit permits future replacement of below grade piping. May also be used for protection of above grade piping in marina applications. Not acceptable for double containment purposes. Environ, GeoDuct Conduit

J. Flexible Piping Fittings (UL 971 Listed):

1. Coax Couplings and Fittings (containment sump installations only):
 - a. Coax Couplings and Fittings: Attach double wall couplings (Coax Coupling-D) specifically manufactured for attachment to GeoFlex®-D piping with manufacturer's coupling machine. Environ Coupling Machine will internally expand metal pipe insert to flexible pipe. Coax fittings and adapters attach with coupling assembly's external coax compression fitting. Couplings and fittings are designed to maintain interstitial space for containment, testing, and monitoring. Available in 1-1/2-inch size only.
2. Swivel Couplings and Fittings (containment sump and/or direct burial installations): Attach single wall swivel pipe coupling specifically manufactured for attachment to GeoFlex®-D piping with manufacturer's coupling machine. Environ Coupling Machine will internally expand metal pipe insert to flexible pipe. For piping applications which are routed in series, Swivel Junction Tees should be fitted with Rubber Test Boots and Connector Tubes to permit interstitial space of piping to bypass single wall fitting for testing and monitoring purposes. Available in 3/4, 1-1/2, 2, and 3-inch sizes.
3. Barbed Pipe Connectors and Fittings: Secure single wall barbed pipe connectors specifically manufactured for attachment to GeoFlex®-D piping with Barbed Clamp Assemblies. For piping applications which are routed in series, Barbed Connectors and Barbed Tees should be fitted with Rubber Test Boots and Connector Tubes to permit interstitial space of piping to bypass single wall fitting for testing and monitoring purposes. Available in 1-1/2, 2, and 3-inch sizes.

2.2 VALVES

- A. General Requirements: Valve products provided for use with fuel-oil systems UL 842 listed. Additional valve standards and valve construction standards are listed specific to type of valve specified.
- B. Equipment Isolation Ball Valves:
1. Pipe 2-1/2-inches and Smaller: AGA/CGA 3.16-M88, and ASME B16.33 compliant, two-piece, bronze body, non-lubricated, threaded connections, full-port ball valves. Rated for 125-PSIG maximum pressure. Nibco, T-585-70-UL (1/4-inch to 1-inch) and Nibco, T-580-70-UL (1-1/4-inch to 2-1/2-inch).
 2. Pipe 2-1/2-inches and Smaller: ASME B16.34, ANSI/API 608 compliant, metal bodied body, non-lubricated, flanged or butt-welded connections, full-port ball valves. Rated for Class 150 and Class 300 applications.
- C. Sectional Isolation Ball Valves
1. Pipe 2-1/2-inches and Smaller: MSS SP-110, and ASME B16.33 compliant, three-piece, bronze body, non-lubricated, threaded connections, full-port ball valves. Rated for 250-PSIG maximum pressure. Nibco, T-595Y-70-UL (1/4-inch to 2-inch) and Nibco, T-590Y-70-UL (2-1/2-inch only).
 2. Pipe 2-1/2-inches and Smaller: ASME B16.34, ANSI/API 608 compliant, metal bodied body, non-lubricated, flanged or butt-welded connections, full-port ball valves. Rated for Class 150 and Class 300 applications.
- D. Sectional Isolation Gate Valves

1. Pipe 2-1/2-inches and Smaller: ANSI/API 600, ISO 10434 compliant, heavy-duty steel, bolted bonnet body, corrosion resistant, threaded connections, full-port gate valves. Rated for 250-PSIG maximum pressure.
 2. Pipe 3-inches and Larger: ASME B16.34, ANSI/API 603 compliant, metal bodied body, non-lubricated, flanged or butt-welded connections, full-port ball valves. Rated for Class 150, Class 300 and Class 600 applications.
- E. Fuel-Oil Safety Valves: Metal body valve with threaded connections, construct for fuel-oil, Grade No. 2 or lighter oil applications. Valve is rated for inlet pressures from 0 to 60-PSIG. Valve will limit inlet pressure on burner pumps to maximum 3-PSIG. Webster, OSV Series.
- F. Fuel-Oil Regulating Valves: Metal body valve with threaded connections, construct for fuel-oil, Grades No. 1 through Grade No. 6 applications. Valve is rated for inlet pressures from 0 to 500-PSIG maximum inlet pressure. Webster, RV Series.
- G. Fuel-Oil Pressure Relief Valves: Metal body valve with threaded connections, construct for fuel-oil, Grades No. 1 through Grade No. 6 applications. Valve is rated for inlet pressures from 0 to 500-PSIG maximum inlet pressure with multiple outlet pressure ranges between 10-PSIG and 330-PSIG. Webster, RV-2000 Series.
- H. Fuel-Oil Relief and Back Pressure Regulating Valve: Bronze or stainless steel body with four adjustable ranging between 1-PSIG to 300-psg, threaded connections from 1/2-inch through 3-inch, rated for 300-PSIG at 180F. Valve is used for fuel-oil pump bypass. Watson-McDaniel, Series R.
- I. Anti-Siphon Valve:
1. Furnish and install at the high point of the oil suction line a UL-listed and labeled anti-siphon valve. Valves that do not have an Underwriters Laboratory certification, listing and label and do not conform to local, state and federal fire codes not acceptable. The anti-siphon valve reduces fire hazards and prevents oil spills caused by oil being siphoned from the storage tank onto the equipment room floor. The valve automatically shuts off the oil flow in the event of a broken or inadvertently left open oil suction line. In the event of a fire, to avoid thermal expansion induced valve failure the anti-siphon valve body material must be bronze. Anti-siphon valves supplied with cast iron bodies or without a UL labels to be removed and a UL-certified bronze body valve will be installed at the Contractor's expense. Valve sized to meet the flow and vertical pipe height requirements of the system. Preferred Utilities Mfg. Corp. Danbury, CT, Model A-DGB-1241 Anti-Siphon Valve.
- J. Lever Gate Valve:
1. Provide and install, where shown in the fuel oil supply line, a quick closing, spring loaded, lever gate valve held open by a wire with fusible link arranged so that the valve will automatically close if the link melts. The valve must be equipped with an automatic fuel shut-off limit switch assembly. Switch assembly wired to the fuel oil management system to provide "Fire" and "Loss of Fuel Supply" alarms and interlock fuel oil pump set operation. Preferred Utilities Mfg. Corp., Danbury, CT, Model 110-DGB-1241 Oil Lever Gate Valve with an Automatic Fuel Shut-off Limit Switch Assembly.
- K. Foot Valve
1. Double Poppet Foot Valves: If the top of the tank is located below the centerline of the pump, provide and install on the tank suction stub a bronze double poppet foot valve of bronze construction, with lapped-in seats, flat poppets and 20 mesh monel screen. Valve: Preferred Utilities Mfg. Corp., Danbury, CT, Model 22-DGB-1241 (add -2 for 2-inch size) Double Poppet Foot Valves. Furnish and install at the tank suction stub exit the Model 233-FV-DGB-1241 Foot Valve Extractor Fitting. Foot Valve Extractor Fitting: Preferred Utilities Mfg. Corp., Danbury, CT, Model 233-FV-DGB-1241.
- L. Tank Selector Valve
1. Furnish and install tank selector valve for manifolding the fuel oil storage tanks. Valve incorporates 6 valve connections in a common casting with a single operating lever for tank selection and visible indication of tank use. The selector valve for the transfer set is manually operated. Reference the mechanical drawings for piping arrangement. "Sure-tite" plug

material supplied to prevent low of pump set prime. Preferred Utilities Mfg. Corp., Danbury, CT, Tank Selector Valve.

2. Selector valve actuator operated to allow for the automatic tank selection control via the fuel oil management control cabinet. Actuator has two end switches to determine which tank has been selected. Operated by control switches integral to the fuel oil management control center. Tank selected as the primary tank and will have automatic switchover in the case of a low level fuel alarm.

M. Fuel Oil Fusible Valves:

1. Globe Valve: Morrison 939.
2. External Valve: Morrison 346.

N. Fuel Oil Solenoid Valve: Morrison 710.

O. Fuel Oil Turbine Pumps:

1. Pump: submersible turbine type, designed to pump fuel-oil single stage, close coupled mounting with motor, variable length, Viton seals, venture type siphon primer, integral pressure relief, air eliminator, and check valve, UL and CSA listed.
2. Motor: Single or three phase motors; automatic thermal overload, TEFC, premium efficiency.
3. Controls: Provide pressure sending devices to automatically control pump operation. Controller to include protection for dry run condition, extended run time, open or low circuit detection, and pump failure detection. Controller to be furnished with RS485 communication port for on-site or remote diagnostic functions. Provide motor starters, disconnects, and terminal block for connection to tank level controls.
4. Manufacturers: FE Petro, Red Jacket, or approved equivalent.

2.3 UNDERGROUND STORAGE TANK SYSTEM (UST)

A. Provide double-wall "Hybrid" underground storage tank for storage of diesel at near atmospheric pressure. Tank is non-domed (flat) heads and dry interstice:

1. Manufacture primary steel tank in accordance with UL standard 58 requirements.
2. Outer (secondary) fiberglass tank minimum 100-mil thickness and manufactured in accordance with UL 1746 standards.
3. Tank to have 360-degree double-wall construction.
4. Interstitial Space: Dry and constructed to allow continuous monitoring of entire interstice for life of tank.
5. Supply and install an interstitial leak sensor (float switch) within interstitial monitoring tube by tank manufacturer. Sensor assembly hermetically sealed to prevent moisture or contamination from entering interstitial space. Provide lead wires to allow connection to site's monitoring panel.
6. Metal thickness per UL 58 on inner tank walls and heads. Steel equal to ASTM A-36, or better, for chemistry and weldability quality.
7. Manufacturing dimensional tolerances for primary tank to be -0 percent/+5 percent.
8. Completely contain primary steel tank within fiberglass outer tank. Seal and coat exposed metal surfaces to ensure protection from corrosion.
9. Tank Testing by Tank manufacturer at factory:
 - a. Tank(s) Underwriters Laboratories listed and tested under UL-58 and UL-1746.
 - b. Pressure test primary tank at 3 to 5 PSI and surfaces soaped and inspected for leaks.
 - c. Test together finished outer tank with primary tank by applying at least 25-inches of mercury (Hg) vacuum to interstice for minimum of 4 hours with no loss.
10. Tank Testing at Job Site:
 - a. Ship tank(s) with minimum 13-inches mercury (Hg) vacuum.
 - b. Maintain interstitial vacuum maintained during transporting tank to site, unloading and storage.
 - c. Verify vacuum on arrival at jobsite.

- d. Test Period: 12 hours for 10,000 gallon and smaller tanks and 24 hours for larger tanks. Any loss of vacuum in excess of 5-inches of mercury during test period is unacceptable. Record vacuum change, if any.
 - e. If necessary, perform corrections, repairs and retesting by tank manufacturer.
 - f. If repairs are made to tank, reestablish 13-inches of mercury vacuum on tank and hold for an additional period of 24 hours.
 - g. If tank again fails to maintain at least 8-inches of mercury vacuum at conclusion of test, return tank to manufacturer.
- 11. Upon successful completion of vacuum test, connect lead wires of factory-supplied interstitial leak sensor (float switch) to site's monitoring panel, in accordance with manufacturer's instructions, NEC, and applicable local code requirements.
- 12. Number, sizes and locations of tank openings are shown on drawings.
- 13. Provide 1/4-inch-thick Type 316L stainless steel striker plates beneath openings.
- 14. Manufacturer to determine number, type and placement of lifting lugs.
- 15. Legible placard with UL number, protected from physical damage during shipping.
- 16. Provide fittings for removable lift lugs. Plug unused fittings and make watertight with an FRP coating when work is completed.
- 17. Tanks compatible with ethanol and methanol fuels.
- 18. Tank manufacturer provides hold down straps and insulating cushioning material (to protect tanks from damage from straps).
- 19. Provide turnbuckles and dead men anchors or other method of compensating for tank buoyancy.
- 20. Protect exterior tank bottoms from physical damage during shipping and storage with protective padding.
- B. Provide tanks with following warranties:
 - 1. 30-year limited warranty against failure caused by non-corrosion related structural failure; corrosion caused by reaction of tank with its soil environment; and internal corrosion for those tanks equipped with wear plates and used to store heating or motor fuels, including alcohols and other compatible chemicals.
 - 2. Manufacturer warranty against failure due to defective materials and workmanship for 1 year following date of delivery of tank to job site.
- C. Contractor or Owner registers each tank and serial number with Steel Tank Institute in accordance with instructions provided by manufacturer with tank.
 - 1. Installing contractor completes Install Checklist, and leaves with owner.
- D. Provide 42-inch diameter sump ring and piping containment sump with each tank.
 - 1. Sump riser sized for burial depth, and bonded to tank to make liquid tight seal.
 - 2. Bond fiberglass sump ring to tank.
 - 3. Pipe and conduit penetrations fittings liquid tight.
 - 4. 36-inch, grade level, gasketed, bolt-down, liquid tight manway cover and ring.
- E. Provide tank hold-down assemblies, isolation straps, turnbuckles and anchoring to prevent tank from rising due to force of buoyancy. Submit calculations of hold down system. Calculations to be stamped by structural engineer.
 - 1. Tank Hold Down Assemblies: Stainless steel construction and coated to prevent corrosion.
 - a. Steel 1/4-inch thick, and of sufficient length to provide proper anchoring of tank.
 - b. Steel band rolled to match diameter of tank.
 - c. Steel band has U-bolt assemblies on either end for attachment to turnbuckles.
 - 2. Isolating/cushioning straps be of 1/8-inch rubber, and of sufficient length to provide cushioning and isolation between tank and holds its own assembly.
- F. Provide tank with EPA mandated venting, spill containment, and overfill protection systems.

1. Components provide complete compliance with Uniform Fire Code, and requirements of Environmental Protection Agency and/or Oregon Department of Environmental Quality.
 2. Components include:
 - a. Minimum 5-gallon capacity grade level overfill/spill containment manhole for fill pipe riser. Manufacturers are OPW, EMCO Wheaton, or approved equivalent.
 - b. An overfill prevention valve provides positive shutoff.
 - c. Valve reduces flow at 95 percent, and completely close at 98 percent of tank capacity.
 - d. Valve: Integral part of drop tube.
 - e. Valve provides completely automatic operation, and not depend upon alertness or response of personnel.
 - f. Valve: Made by OPW, EMCO Wheaton, or approved equivalent.
 3. Vent extractor fitting with vent cap.
 - a. Extractor Fitting: 4- by 4- by 2- by 2-inch variety with ability to provide for Stage I vapor recovery in future.
 - b. Provide extractor with plug and cap.
 - c. Vent cap: 2-inch updraft vent.
 - d. Extractor: Made by OPW, EMCO Wheaton, or approved equivalent.
 4. Fill pipe band to identify fuel being stored in tank.
 5. 4-inch swivel fill adapter and cap, as made by OPW, EMCO Wheaton, or approved equivalent.
- G. Tank Manufacturer: Ace Tank and Equipment Co., or approved equivalent.

2.4 LEAK DETECTION SYSTEM FOR UNDERGROUND STORAGE TANKS

- A. Provide where shown on the Drawings a switch for leak sensing on containment piping within the building. Switch located at the end of each pitched horizontal run. Switches integrate with fuel oil management control center. Preferred Utilities Mfg. Corp., Danbury, CT, Model RBS-DGB-1241.

2.5 FUEL-OIL FILL PORTS

- A. Fuel-Oil Tank Fill Port: 4-inch locking tank fill with gasket and 2-inch float vent with stainless steel ball float to prevent overflow at vent pipe. Clay and Bailey CB94-4, OPW.
- B. Fuel-Oil Remote Fill Port: Fill port assemble, flush mounted or surface mounted to wall adjacent to aboveground storage tank (AST). Assembly to be steel constructed and painted with white epoxy coating both interior and exterior, furnished with locking door. Assembly will provide 7-1/2 gallon spill containment with hand operated pump, be weatherproof, and have an exterior grounding lug. 2-inch inlet fitting with an isolation valve, check valve, and dust cover. Simplex Fill Port assembly with optional features as indicated in drawings.
- C. Fuel-Oil Remote Fill Port: Fill port assemble with overfill prevention valve (Morrison Brothers 9095A), surface mounted to the aboveground storage tank (AST). Assembly to be steel constructed and painted with a white epoxy coating both interior and exterior, furnished with a locking door. The assembly will provide 7-1/2 gallon spill containment with a hand operated pump, be weatherproof, and have an exterior grounding lug. A 3-inch inlet fitting with an isolation valve, check valve, and dust cover. Simplex Fill Port assembly with optional features as indicated in the Drawings.

END OF SECTION

SECTION 232113 HVAC PIPING

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Equipment Drains and Overflows
 - 2. Unions
 - 3. Refrigerant Piping

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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.

1.5 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.
 - 4. Refrigerant Piping:
 - a. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications."
 - b. ASHRAE Standard: Comply with ASHRAE 15, "Safety Code for Mechanical Refrigeration."
 - c. ASME Standard: comply with ASME B31.5, "Refrigeration Piping."
 - d. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical" or UL 429 "Electrically Operated Valves."

1.6 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

2.1 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.

2.2 UNIONS

- A. Unions for Pipe 2-inches and Under:
 - 1. Ferrous Piping: 150, 250, and 300 PSIG malleable iron, threaded, ASME B16.39.
 - 2. Copper Pipe: Bronze, soldered joints, ASME B16.22.
- B. Dielectric Connections: Provide dielectric waterway or brass nipple fitting with threaded ends. Dielectric unions are not allowed.

2.3 REFRIGERANT PIPING

- A. Piping:
 - 1. Copper Tube: ASTM B 280, Type ACR, drawn-temper tube, clean, dry and capped.
 - a. Fittings: ASME B16.22 wrought copper.
 - b. Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy (15 percent Silver).
 - 2. Copper Tube to 5/8-inch OD: ASTM B280. Tube ACR, annealed-temper copper tube, clean, dry and capped.
 - a. Fittings: ASME B16.26 cast copper.
 - b. Joints: Flared.
- B. Moisture and Liquid Indicators:
 - 1. Manufacturers:
 - a. Henry Technologies.
 - b. Parker Hannifin/Refrigeration and Air Conditioning.
 - c. Sporlan Valve Company.
 - d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements requirements.
 - 2. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum temperature of 200 degrees F and maximum working pressure of 300 PSI.
- C. Valves:
 - 1. Manufacturers:
 - a. Hansen Technologies Corporation.
 - b. Henry Technologies.
 - c. Danfoss Flomatic.
 - d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
 - 2. Packaged Ball Valves:

- a. Two piece bolted forged brass body with Teflon ball seals and copper tube extensions, brass seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of and maximum temperature of 300 degrees F.

D. Filter-Driers:

- 1. Manufacturers:
 - a. Flow Controls Division of Emerson Electric.
 - b. Parker Hannifin/Refrigeration and Air Conditioning.
 - c. Sporlan Valve Company.
 - d. Substitutions: See Section 23 00 00, HVAC Basic Requirements, Division 00, Procurement and Contracting Requirements and Division 01, General Requirements.
- 2. Performance:
 - a. Flow Capacity - Liquid Line: As required by equipment manufacturer, rated in accordance with ARI 710.
 - b. Flow Capacity - Suction Line: As required by equipment manufacturer, rated in accordance with ARI 730.
 - c. Water Capacity: As recommended by equipment manufacturer, rated in accordance with ARI 710.
 - d. Pressure Drop: No greater than maximum recommended by equipment manufacturer, when operating at full connected evaporator capacity.
 - e. Design Working Pressure: 350 PSI, maximum.
- 3. Cores: Molded or loose-fill molecular sieve desiccant compatible with refrigerant, activated alumina, and filtration to 40 microns; of construction that will not pass into refrigerant lines.
- 4. Construction: UL listed.
 - a. Replaceable Core Type: Steel shell with removable cap.
 - b. Sealed Type: Copper shell.
 - c. Connections: As specified for applicable pipe type.

END OF SECTION

SECTION 233100 HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Ductwork, Joints and Fittings
 - 2. Type I, Grease Hood Ductwork
 - 3. Laundry Clothes Dryer Vent
 - 4. Insulated Flexible Duct
 - 5. Drain Pans
 - 6. Ductwork Joint Sealers and Sealants

1.2 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.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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

1.5 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. If required, provide ductwork pressure testing per Section 23 05 93, Testing, Adjusting and Balancing for HVAC.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 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

2.1 MANUFACTURERS

- A. Ductwork, Joints, and Fittings:
 - 1. Ductmate
 - 2. Lindab Inc
 - 3. Nexus Inc
 - 4. SEMCO
 - 5. United McGill Corporation
 - 6. Ward Industries
 - 7. Or approved equivalent
- B. Type 1, Grease Hood Ductwork:
 - 1. CaptiveAire
 - 2. Metal-Fab
 - 3. Security Chimneys International
 - 4. Selkirk
 - 5. Or approved equivalent.
- C. Insulated Flexible Duct:
 - 1. ATCO
 - 2. Flexmaster
 - 3. J.P. Lamborn Co.
 - 4. Hart and Cooley
 - 5. Or approved equivalent
- D. Ductwork Joint Sealers and Sealants
 - 1. Ductmate
 - 2. Durodyne
 - 3. Hardcast
 - 4. United McGill Corporation
 - 5. Vulkem
 - 6. Or approved equivalent

2.2 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.
 3. Stainless Steel: Fabricated in accordance with ASTM A167 and A480.
- 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 Diameter: 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.
- H. Flat Oval Duct
1. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with circumference equal to the perimeter of a given size of flat-oval duct.
 2. Flat Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's HVAC Duct Construction Standards-Metal and Flexible. Fabricate ducts larger than 72-inches in diameter with butt-welded longitudinal seams.
 3. Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.
 4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
 5. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

2.3 TYPE I, GREASE HOOD DUCTWORK

- A. Materials:
1. Carbon Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, matte finish for exposed ducts.
- B. Construction:
1. Weld or braze all joints, seams, and penetrations continuously and liquid tight on the external surface of the duct system.

2.4 LAUNDRY CLOTHES DRYER VENT

- A. Aluminum sheet metal, minimum 24 gauge. Substantially airtight duct except for openings required for operation and maintenance. Duct to have smooth interior surface. Do not assemble with sheet metal screens or other devices that extend into the airstream.

2.5 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.

2.6 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.

2.7 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 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 when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts. Min. 69 percent solids, nonflammable. Durodyne Duroseal, Hardcast Versa-Grip 181, McGill United Duct Sealer.
- F. Solvent Based Sealant for Brush-On Application: One-part, nonsag, solvent-release-curing, polymerized butyl sealant with a minimum of 75 percent solids, nonflammable. McGill Uni-Coat, Hardcast Sure-Grip, 404.
- G. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C920, Type S, Grade NS, Class 25, Use O.
- H. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.
- I. Two-Part Tape and Adhesive System: Hardcast FTD 20/DT, McGill Air Seal Uni-Cast.
- J. Silicon Sealant: Hardcast PT-302 or equal.
- K. Polyurethane Sealant: General-purpose non-brittle sealant for gunned application. Vulkem 616 or equal.

END OF SECTION

SECTION 233300 AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 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. Turning Vanes
 - 9. Flexible Connectors
 - 10. Air-to-Air Heat Exchangers

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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.

1.5 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. CSFM - California State Fire Marshal Listing for Fire Damper and Smoke Damper.
6. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
7. NFPA 92A - Smoke-Control Systems.
8. NFPA 92B - Smoke Control Systems in Atria, Covered Malls and Large Areas.
9. NFPA 101 - Life Safety Code.
10. UL 555 - Standard for Safety; Fire Dampers.
11. UL 555S - Standard for Safety; Leakage Rated Dampers for Use in Smoke Control Systems.

1.6 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

2.1 MANUFACTURERS

- A. Backdraft Dampers:
 1. Air Balance
 2. Cesco
 3. Greenheck
 4. Nailor
 5. Ruskin
 6. Or approved equivalent.
- B. Dampers:
 1. Air Balance
 2. Cesco
 3. Greenheck
 4. Nailor
 5. Ruskin
 6. Or approved equivalent.
- C. Concealed Damper Hardware, Cable System:
 1. Young Regulator Company
 2. Or approved equivalent.
- D. Access Doors:
 1. Ductmate
 2. Cesco
 3. Ruskin
 4. Nailor
 5. Outdoor Installation: Karp MX insulated exterior access door.
 6. Or approved equivalent.
- E. Duct Test Holes:
 1. Ventlok
 2. Or approved equivalent.
- F. Combination Fire and Smoke Dampers:
 1. Ruskin
 2. Greenheck

3. CESCO
 4. Air Balance
 5. Nailor
 6. Or approved equivalent.
- G. Turning Vanes:
1. Aerodyne
 2. Ductmate Industries
 3. Duro Dyne Corp
 4. Metalaire Inc.
 5. Ward Industries
 6. Or approved equivalent.
- H. Flexible Connectors:
1. Duro Dyne Corp.
 2. Ventfabrics Inc.
 3. Ward Industries
 4. Or approved equivalent.
- I. Air-to-Air Heat Exchangers:
1. Xetex
 2. Heatex
 3. AEX
 4. Heat-X-Changer
 5. Or approved equivalent.

2.2 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.

2.3 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.

2.4 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.

2.5 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.

2.6 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.

2.7 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.

2.8 COMBINATION FIRE AND SMOKE DAMPERS

- A. Basis-of-Design:
 - 1. Ruskin Model FSD36, Leakage Class II, 1-1/2 hour rated, for use downstream of terminal units.
 - 2. Ruskin Model FSD25R, Leakage Class 1, 1-1/2 hour rated, for use downstream of terminal units.
 - 3. Ruskin Model FSD60, Leakage Class I, 1-1/2 hour rated, for use upstream of terminal units.
 - 4. - C, for use in tunnel corridor applications.
 - 5. - FA, front access models.
 - 6. - SS, Stainless Steel Models for use in stainless steel ductwork.
 - 7. - M, modulating.
 - 8. - VALR, for use in validated systems.
 - 9. XP, for use in explosion proof applications.
 - 10. - 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. Fire Stat:
 - 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.
 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.

2.9 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners to automatically align vanes.
- B. Manufactured Turning Vanes: For medium pressure ductwork, ductwork upstream of terminal units, and in ductwork with equal inlet width and height dimensions and outlet width and height dimension, provide double thickness airfoil turning vanes. Low pressure ductwork and ductwork downstream of terminal units use either single thickness or double thickness turning vanes. For mitered rectangular elbows with changes in size from inlet to outlet, only use single thickness turning vanes. Use 2-inch radius vanes spaced on centers of 1.5-inches for single thickness. Use 2-inch radius vanes spaced on centers of 2.125-inches for double thickness.
- C. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.10 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. Indoor System, Flexible Connector Fabric (FC-1): Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 ounces per square yard.
 - 2. Tensile Strength: 480 pounds of force per inch in the warp and 360 pounds of force per inch in the filling.
 - 3. Service Temperature: -40 degrees F to 200 degrees F.
- D. Outdoor System, Flexible Connector Fabric (FC-O): Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
 - 1. Minimum Weight: 24 ounces per square yard.
 - 2. Tensile Strength: 530 pounds of force per inch in the warp and 440 pounds of force per inch in the filling.
 - 3. Service Temperature: -50 degrees F to 250 degrees F.
- E. 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.
- F. 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.

2.11 AIR TO AIR HEAT EXCHANGERS

- A. Maximum static pressure drop for assembly: 0.15-inch wg at 2000-feet per minute.
 - 1. Unit suitable for installation downstream of fans as shown.
 - a. Cross flow, flat plate air heat exchanger assembly, consisting of base and steel housing assembly, aluminum heat exchanger, exhaust filter rack, and integral drain pans.
 - b. Heat exchanger be minimum 95 percent pure aluminum flat plates, tested to withstand 10-inches WG between air streams. Maximum air temperatures of 220 degrees F. Unit cross contamination certified by independent lab to be less than 0.01 percent of maximum airflow.
 - 1) Housing to be heavy gauge galvanized steel.
 - 2) Air Sentinel, Air Monitor Corporation.
 - 3) Filter housing on exhaust air inlet to accommodate two 4-inch thick filter assemblies of standard dimensions.

END OF SECTION

SECTION 233400 HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Centrifugal Fans
 - 2. Roof Exhaust Fans
 - 3. Dryer Vent Exhaust Fans

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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.

1.5 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.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 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.

1.8 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.

1.9 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Belts: One set for each belt-driven unit.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Centrifugal Fans:
 - 1. Greenheck
 - 2. Twin City
 - 3. Loren Cook Company
 - 4. PennBarry.
 - 5. American Fan
 - 6. Or approved equivalent.
- B. Roof Exhaust Fans:
 - 1. Greenheck
 - 2. Cook
 - 3. Carnes
 - 4. PennBarry
 - 5. Twin City
 - 6. Or approved equivalent.
- C. Dryer Vent Exhaust Fans:
 - 1. Fantech Inc.
 - 2. Tjernlund
 - 3. Or approved equivalent.

2.2 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. Forward Curved: Black enameled or galvanized steel construction with inlet flange, back plate, shallow blades with inlet and tip curved forward in direction of airflow, mechanically secured to flange and back plate; steel hub swaged to back plate and keyed to shaft with set screw.
3. 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.
4. Radial: Steel construction with inlet flange, heavy reinforced back plate, plate blades with reinforcing gussets and wearing strips, welded or riveted to back plate and flange, cast iron or cast steel, hub riveted to back plate and keyed to shaft with set screws.
5. 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 50,000 hours, ball bearings, with ABMA 9 L-10 life at 100,000 hours, roller bearings, or ABMA 11, life at 120,000 hours, or roller bearings, or ABMA 11, life at 400,000 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. Discharge Dampers: Parallel blade 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.

2. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
3. Access Doors: Shaped to conform to scroll, with quick opening latch type handles and gaskets.
4. Scroll Drain: 1/2-inch steel pipe coupling welded to low point of fan scroll.
5. Weather Hoods: Heavy gauge protective covers over bearings and shaft assembly for fans exposed to weather.
6. AMCA 99 Type B spark proof construction where scheduled.
7. 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.
8. Vibration isolation as scheduled and specified. Reference Section 23 05 48 Vibration and Seismic Controls for HVAC Piping and Equipment.
9. Provide Class H insulation on motors used for smoke control.

2.3 ROOF EXHAUST FANS

- A. Description: Belt-driven or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.
- B. Wheel:
 1. Single width, single inlet, backward inclined/airfoil blades
 2. Aluminum hub and wheel with steel inlet bell.
 3. Statically and dynamically balanced with its own bearings.
- C. Housing to match scheduled Basis of Design:
 1. One piece heavy gauge spun aluminum dome, hinged for service.
 2. Low silhouette type with arched heavy gauge galvanized hood
 3. Louvered type with heavy gauge extruded aluminum louvers
 4. Upblast discharge, heavy gauge spun aluminum, UL 762 for kitchen grease exhaust. Provide rain and snow drains.
- 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.
- E. Pulleys: Cast-iron, adjustable-pitch motor pulley.
- F. Fan and motor isolated from exhaust airstream.
- G. Curb: Prefabricated insulated roof curb, galvanized steel, mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer, hinged with curb seal. Provide curb for flat, pitched or ridged roof as indicated.
 1. Security grates in curb, 1/2-inch powder coated steel bars, 6 by 6-inch grid. Provide where scheduled.
 2. Kitchen grease exhaust meeting NFPA-96 requirements with vented slots. Greenheck VPFV or equal.
 3. Sound curb: Curb with sound-absorbing insulation matrix. Provide where scheduled.
- H. Motor: Integrally mounted, 1800 RPM maximum, with pre-lubricated sealed ball bearings. ODP for motors located indoors and TEFC for motors exposed to moisture.
 1. Inverter duty motor for use with variable frequency drive where indicated on Fan Schedule on Drawings.
 2. Electrically Commutated Motor (ECM) where indicated on Fan Schedule on Drawings.
- I. Accessories:

1. Inlet/Outlet Screens: Galvanized steel welded grid, removable.
2. Backdraft Damper: Parallel blade 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.
3. AMCA 99 Type B spark proof construction where scheduled.
4. 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.
5. Variable-Speed Controller: Where scheduled on Drawings, provide solid-state control to reduce speed from 100 percent to less than 50 percent.
6. Disconnect Switch: Where not shown on Division 26, Electrical Drawings, provide nonfusible type, with thermal-overload protection mounted inside fan housing factory wired through an internal aluminum conduit.
7. Vibration Isolation: Wheel and motor mounted on integral double deflection neoprene isolators.

2.4 DRYER VENT EXHAUST FANS

- A. Description: UL-Listed in-line dryer vent exhaust for suitable for high moisture, dust, and lint loadings. Suitable for temperatures up to 140 degrees F.
- B. Housing constructed of UV resistant ABS-PC Blend thermoplastic.
- C. Wheel: Backward curved impellers with venture inlet.
- D. Accessories:
 1. Secondary lint trap installed upstream of fan. Fantech DBLT4 or approved equivalent.
 2. Automatic switch to turn on/off fan set at 0.05-inches WG. with delay-on-break timer to maintain fan operation for up to 10 minutes after dryer is off.
 3. Integral external electrical terminal box with class B wiring and terminal strip.
 4. Internally mounted capacitor.

END OF SECTION

SECTION 233500 REFRIGERATION DETECTION AND ALARM

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Functional Description of Refrigerant Monitoring Systems
 - 2. Refrigerant Monitor
 - 3. SCBA
 - 4. Control Cable
 - 5. Source Quality Control

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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 SCBA; include mounting details and service requirements and compliance with authorized Federal agency.
 - 2. Shop Drawings: For each type of refrigerant monitor; include refrigerant ppm range, temperature range, alarm outputs, readout range, furnished specialties, installation requirements, and power consumption.
 - 3. Wiring Diagrams: Power, signal, and control wiring.
 - 4. Coordination Drawings: Include machinery room layout showing location of monitoring devices in relation to refrigerant equipment.
 - 5. Product Certificates: For monitoring devices and SCBA, signed by product manufacturer.
 - 6. Operation and Maintenance Data: For refrigerant monitoring equipment and SCBA to include in emergency, operation, and maintenance manuals.

1.5 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. ASHRAE: Monitoring system to comply with ASHRAE 15.
 - 2. CFR: SCBA to comply with requirements in 42 CFR 84.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 DEFINITIONS

- A. CMOS: Ceramic metal-oxide semiconductor.
- B. HFC: Hydrofluorocarbon.
- C. IR: Infrared.
- D. LED: Light-emitting diode.
- E. ppm: Parts per million.
- F. SCBA: Self-contained breathing apparatus.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Refrigerant Monitoring Equipment:
 - 1. Davis Instruments Manufacturing Co., Inc.
 - 2. Foxboro Company
 - 3. General Analysis Corp.
 - 4. Genesis International Inc.
 - 5. Thermal Gas Systems, Inc.; Haloguard Monitors.
 - 6. Trane Co.
 - 7. Or approved equivalent.
- B. SCBA:
 - 1. AFC International, Inc.
 - 2. Clarey's Safety Equipment, Inc.
 - 3. Genesis International Inc.
 - 4. MSA, Instrument Division
 - 5. Thermal Gas Systems, Inc.; Haloguard Monitors
 - 6. Or approved equivalent.

2.2 FUNCTIONAL DESCRIPTION OF REFRIGERANT MONITORING SYSTEM

- A. On leak detection by refrigerant sensor(s), the system to perform the following:
 - 1. Activate machinery room ventilation.
 - 2. Activate audio and visual alarm inside and outside machinery room.
 - 3. Notify Building Automation System of alarm condition.

2.3 REFRIGERANT MONITOR

- A. Description: CMOS or IR sensor to continuously measure and display the specific gas concentration and be capable of indicating, alarming, and shutting down equipment, and automatically activating ventilation system. Provide monitor design and construction compatible with temperature, humidity, barometric pressure, and voltage fluctuations of the machinery room operating environment.
- B. Performance Requirements:
 - 1. Refrigerant to Be Monitored: Manufacturer to match refrigerant type to purchased equipment and existing equipment to remain for the project.
 - 2. Refrigerant Concentration: 0 to 1000 ppm.
 - 3. Accuracy: 100 to 1000 ppm; plus or minus 10 percent of reading.
 - 4. Linearity: 100 to 1000 ppm; plus or minus 2 percent of full scale.
 - 5. Sensitivity: 1 ppm.

6. Resolution: 1 ppm.
 7. Operating Temperature: 41 to 104 deg F.
 8. Response Time: 90 percent of a step change in 4 minutes.
 9. Relatively Humidity: 20 to 95 percent, noncondensing over the operating temperature range.
- C. Operating Requirements:
1. Maximum Power Input: 120-V ac; 60 Hz, 30 W.
 2. Alarm Relays: 3 relays at 5- to 8-A resistive load.
 3. Alarm Set Points: Displayed on front of meter.
 4. Audible Output: Sonic alert at 75 to 80 dB at 60-inches.
 5. Analog Output: 0- to 10-V dc or 4- to 20-mA current sourcing.
 6. Serial Output Type: RS 232.
- D. Sensor Configuration: CMOS sensor.
1. Single-sensing channel.
 2. Expandable to four channels.
- E. Display: 10-character, alphanumeric, vacuum-fluorescent indicating lights for each alarm set point; standard alarm; acknowledge switch and test switch mounted on front panel; and alarm status LEDs and service fault LEDs. Enclosure: NEMA 250, type as required for ambient condition.
- F. Alarm Output: Indicating light flashes and horn sounds.
1. Remote unit for mounting outside machinery room and having light beacon with multiple lights.
 2. Field-adjustable alarm set points.
- G. Calibration: Factory calibrated.
- H. Battery: Provide integral battery system for secondary source of power. Battery standby time at full load: 2 hours minimum (longer if required by Code or local AHJ).

2.4 SCBA

- A. Description: Open-circuit, pressure-demand, compressed-air SCBA includes completely assembled, portable, self-contained devices designed for hazardous breathing environment application.
- B. Face Piece: EPDM construction material, one-size-fits-all with double-sealing edge, stainless-steel speaking diaphragm and lens retainer, five adjustable straps to hold face piece to head (two straps on each side and one on top), exhalation valve in mask, close-fitting nose piece to ensure no CO2 build-up, and perspiration drain to avoid skin irritation and to prevent eyepiece, spectacle, and lens fogging.
- C. Backplate: Orthopedically designed of high-strength chemical and impact-resistant glass-fiber composite.
- D. Harness and Carrier Assembly: Large triangular back pad, backplate, and adjustable waist and shoulders straps. Modular in design, detachable components, and easy to clean and maintain. Shoulder straps are padded with flame-resistant material and reinforced with stainless-steel cable and attached with T-nuts, washers, and screws; rivets are not permitted.
- E. Air Cylinder: 45-minute, low-pressure, air-supply-loaded aluminum cylinders fitted with quick-fill assembly for refilling and air transfer.
- F. Wall-Mounted Case: Leakproof, corrosion-resistant, tough, plastic case.

2.5 CONTROL CABLE

- A. Provide electronic and fiber-optic cable for control wiring as specified in Division 26, Electrical.

2.6 SOURCE QUALITY CONTROL

- A. SCBA: Tested and certified by the National Institute for Occupational Safety and Health and the Mine Safety and Health Administration according to 42 CFR 84, Subpart H.
- B. Refrigerant Monitor: Factory tested and certified.

END OF SECTION

SECTION 233700 AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Grilles, Registers, Diffusers
 - 2. Louvers
 - 3. Operable Louvers
 - 4. Roof Vents

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 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.

1.5 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.

1.6 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

2.1 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. Kruger
 - 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.
- D. Operable Louvers:
 - 1. Ruskin Manufacturing
 - 2. Pottorff
 - 3. Carnes
 - 4. Cesco
 - 5. Greenheck
 - 6. Or approved equivalent.
- E. Roof Vents:
 - 1. Western
 - 2. Or approved equivalent.

2.2 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. 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.
- D. Coordinate mounting frames with ceiling construction type. Verify per reflected ceiling plans.

2.3 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.

2.4 OPERABLE LOUVERS

- A. Provide and install operable louver with built-in rain stop design. Blades 4-inches on center, formed of 20 gauge galvanized steel. Furnish with bird screen on inside face, duct collar and flanged frame. Provide linkages required for one point motor operation. Prime coat finish. Screen to be installed in frame.
- B. Coordinate actuator location for accessible maintenance. Coordinate linkage, actuator type, control sequence.
- C. Reference drawing for free area required.
- D. 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.

2.5 ROOF VENTS

- A. Standard Type: Furnish and install to match roof exhaust fan hoods. Sizes shown on Drawings. Provide accessories, such as inlet motorized damper, curb, screens per drawings and schedule.
- B. Turbine Type: Furnish and install Turbine Roof Ventilator.

END OF SECTION

SECTION 234000 HVAC AIR CLEANING DEVICES

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Disposable Panel Filters
 - 2. Medium Efficiency Pleated Filters
 - 3. High Efficiency Pleated Filters
 - 4. Filter Gauges

1.2 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.

1.3 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. ARI 850 - Commercial and Industrial Air Filter Equipment; Air-Conditioning and Refrigeration Institute.
 - 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.

1.4 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.

1.5 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.

1.6 WARRANTY

- A. Warranty of materials and workmanship as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.7 PERFORMANCE REQUIREMENTS

- A. Conform to ARI 850, Standard for Performance Rating of Commercial and Industrial Air Filter Equipment, Section 7.4.
 1. Dust Spot Efficiency: Plus or minus 5 percent.

PART 2 PRODUCTS

2.1 FILTER MANUFACTURERS

- A. American Filtration Inc.
- B. AAF International/American Air Filter
- C. Camfil Farr Company
- D. Eco-Air Products
- E. Filtration Group
- F. Flanders Corporation
- G. Or approved equivalent.

2.2 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. Initial Resistance: 0.15-inch WG.
 3. Recommended Final Resistance: 0.50-inches WG.
 4. 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.

2.3 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.

2.4 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.

2.5 FILTER GAUGES

- A. Manufacturers:
 - 1. Dwyer Instruments, Inc; Model 2002-ASF
 - 2. H.O. Trerice Company
 - 3. Weiss Instruments
- B. 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.
- C. 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 2.0-inch WG, 2 percent of full scale accuracy.
- D. 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.
- E. Accessories: Static pressure tips with integral compression fittings, 1/4-inch aluminum tubing, 2-way or 3-way vent valves.

END OF SECTION

SECTION 236201

VARIABLE REFRIGERANT FLOW/VOLUME (VRF/VRV) SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Work Included:
 - 1. Outdoor Unit (Simultaneous Heating and Cooling)
 - 2. Branch Circuit (BC) Controllers (Mitsubishi Systems)
 - 3. Indoor Unit - Ceiling Concealed Ducted
 - 4. Low Profile Ceiling-Concealed Ducted Indoor Unit
 - 5. Controls for VRV Systems
- B. Variable capacity, heat pump air conditioning system.
- C. System consists of an outdoor unit, Branch Circuit Terminal or Branch Selector Units, multiple indoor fan units and PID DDC (Direct Digital Controls). Each indoor unit or group of indoor units capable of operating in any mode independently of other indoor units or groups. System capable of changing mode (cooling to heating, heating to cooling) with no interruption to system operation. Each indoor unit or group of indoor units independently controlled. Sum of connected capacity of indoor air handlers range from 50 percent to 130 percent of outdoor rated capacity.
- D. Variable capacity heat pump system (non-heat recovery) system consist of outdoor unit, multiple indoor units and PID DDC (Direct Digital Controls). Sum of connected capacity of indoor air handlers range from 50 percent to 130 percent of outdoor rated capacity. Heating mode or cooling mode/no simultaneous operation.

1.2 RELATED SECTIONS

- A. Contents of Division 23, HVAC and Division 01, General Requirements apply to this Section.

1.3 REFERENCES AND STANDARDS

- A. References and Standards as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.4 SUBMITTALS

- A. Submittals as required by Section 23 00 00, HVAC Basic Requirements and Division 01, General Requirements.

1.5 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. Facility manufacturing registered to ISO 9001 and ISO 14001.
 - 2. Full charge of R-410A provided in condensing unit from factory.
 - 3. Units to be listed by Electrical Laboratories (ETL) and bear the ETL label.
 - 4. Wiring in accordance with the National Electric Code (NEC).
 - 5. The system will bear the Energy Star label.
 - 6. The installing contractor to receive instruction and training from the equipment manufacturer prior to installation. Instruction to cover manufacturer's recommended methods for piping, wiring, leak testing, etc. Documentation of the training is to be provided to the Architect for review.

1.6 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. Five year warranty on compressor(s)

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Daikin (latest series).
- B. Mitsubishi (latest series).
- C. Approved Alternate Manufacturer: Drawings indicate Basis of Design manufacturer, alternate acceptable manufacturers listed may be provided, meeting capacities of Basis of Design system. Each alternate manufacturer has a specific refrigerant distribution system that is proprietary. Therefore, alternate proposed systems are to include the cost of refrigerant distribution modifications, equipment location modification, condensate and secondary condensate over flow modifications, electrical modifications, architectural modifications, structural modifications, maintenance and access modifications, and other modifications required to submit the manufacturer that is not the Basis of Design.

2.2 OUTDOOR UNIT (SIMULTANEOUS HEATING AND COOLING)

- A. General:
 - 1. Outdoor unit specifically for use with manufacturer VRF/VRV components. Multiple circuit boards that interface to controls system, to perform functions necessary for operation. Outdoor unit module factory assembled, piped and wired and run tested at factory.
 - 2. Outdoor unit sound rating no higher than 60 dB(A) individually or 63 dB(A) twinned. Night mode sound rating no higher than 50 dB(A) individually or 53 dB(A) twinned.
 - 3. Individually insulate refrigerant lines from outdoor unit to indoor units.
 - 4. Accumulator with refrigerant level sensors and controls.
 - 5. High pressure safety switch, over-current protection, crankcase heater and DC bus protection.
 - 6. Heating mode operation down 0 degrees F ambient temperature or cooling mode down to 23 degrees F ambient temperature, without additional low ambient controls.
 - 7. Unit not to cease operation in any mode based solely on outdoor ambient temperature.
 - 8. High efficiency oil separator plus additional logic controls to maintain adequate oil volume in compressor.
 - 9. The system will automatically restart operation after a power failure and will not cause any settings to be lost. System not to require re-programming in the event of power failure.
 - 10. The outdoor unit to be modular in design and to allow for side-by-side installation following manufacturer's recommended clearances.
- B. Unit Cabinet:
 - 1. Casing(s) to be completely weatherproof and fabricated of galvanized steel, bonderized and finished withstand 960 hours per ASTM B117 criteria for seacost protected models.
- C. Fan:
 - 1. Direct drive, variable speed propeller type fan. Factory set for operation under 0-inch WG external static pressure, but capable of normal operation under maximum of 0.24-inch WG external static pressure via dipswitch.
 - 2. Inherent fan motor protection, permanently lubricated bearings, and variable speed.
 - 3. Mounted for quiet operation.

4. Raised guard to prevent contact with moving parts.
 5. Vertical discharge airflow.
- D. Refrigerant:
1. R410A refrigerant.
- E. Outdoor Coil:
1. Nonferrous construction with lanced or corrugated plate fins on copper tubing.
 2. Factory applied corrosion resistant finish on fins.
 3. Integral metal coil guard.
 4. Refrigerant flow controlled by inverter driven compressor.
- F. Compressor:
1. Inverter driven scroll hermetic compressor.
 2. Factory mounted crankcase heater(s).
 3. Inverter capacity modulation. Variable capacity with turndown of 14 percent of rated capacity, depending upon unit size.
 4. Equipped with internal thermal overload.
 5. The compressor(s) to be mounted on rubber-in-shear isolators to avoid the transmission of vibration.
- G. Electrical:
1. The power supply to the outdoor unit to be as scheduled on the drawings.
 2. The control voltage between the indoor and outdoor unit to be 16 VDC or 24 VDC non-shielded 2 conductor cable.
 3. The control wiring to be a two-wire multiplex transmission system, connecting multiple indoor units to one outdoor unit with a single 2-cable wire.

2.3 BRANCH CIRCUIT (BC) CONTROLLERS (MITSUBISHI SYSTEMS)

- A. General: Provide BC (Branch Circuit) Controllers specifically used with R410A R2-Series systems. Provide units equipped with a circuit board that interfaces to the M-NET controls system and to perform functions necessary for operation. The unit to have a galvanized steel finish. Provide BC Controller completely factory assembled, piped and wired. Each unit to be run tested at the factory. Mount unit indoors. The sum of connected capacity of indoor air handlers to range from 50 percent to 150 percent of rated capacity.
- B. BC Unit Cabinet:
1. Casing fabricated of galvanized steel.
 2. Each cabinet to house a liquid-gas separator and multiple refrigeration control valves.
 3. The unit to house two tube-in-tube heat exchangers.
- C. Refrigerant: R410A refrigerant required for CMB-P-NU-G/GA/GB BC Controllers in conjunction with PURY-P-TGMU-A outdoor unit systems.
- D. Refrigerant valves:
1. Provide unit furnished with multiple branch circuits which can individually accommodate up to 54,000 BTUH and/or three indoor units. Branches may be twinned to allow more than 54,000 BTUH.
 2. Each branch to have multiple two-position valves to control refrigerant flow.
 3. Service shut-off valves field-provided/installed for each branch to allow service to any indoor unit without field interruption to overall system operation.
 4. Linear electronic expansion valves to be used to control the variable refrigerant flow.
- E. Integral Drain Pan: Provide an integral condensate pan and drain. A secondary drain pan piped to an observable location to be field installed.

F. Electrical:

1. Unit electrical power: 208/230 volts, 1 phase, 60 hertz.
2. Provide unit capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253V (230V/60Hz).
3. BC Controller controlled by integral microprocessors.
4. Control circuit between the indoor units and the outdoor unit to be 24VDC completed using a 2-conductor, twisted pair shielded cable to provide total integration of the system.

2.4 INDOOR UNIT - CEILING CONCEALED DUCTED

A. General:

1. Ceiling-concealed ducted indoor fan coil design. 2-position, field adjustable return and fixed horizontal discharge supply with modulating linear expansion device.
2. Factory assembled, wired and run tested. Factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. Self-diagnostic function, 3-minute time delay mechanism, and auto restart function.
3. Indoor unit and refrigerant pipes pre-charged with dehydrated air before shipment from factory.

B. Unit Cabinet:

1. Ceiling-concealed, ducted supply and return.
2. Provisions for field installed, filtered outside air intake.

C. Evaporator Fan:

1. One or two fan(s) direct driven by single motor.
2. Statically and dynamically balanced, motor with permanently lubricated bearings.
3. Minimum of two speed settings.
4. Fan to be thermally protected.

D. Filter:

1. Standard factory installed return air filter.
2. Return filter box (rear or bottom placement) with high-efficiency filter as scheduled.

E. Evaporator Coil:

1. Nonferrous construction with smooth plate fins on copper tubing with inner grooves for high efficiency heat exchange.
2. Brazed tube joints with phos-copper or silver alloy.
3. Pressure tested at factory.
4. Condensate pan and drain under coil. Provide with integral condensate pump.
5. Condensate gravity drained from fan coil, with available factory condensate pump.
6. Insulated refrigerant lines.

F. Controls:

1. The unit to have PID controls provided by manufacturer to perform input functions necessary to operate the system. No third party building management system to be required, however, VRV/VRF system to be capable of communicating with third party BMS.
2. The unit to be compatible with interfacing with connection to LonWorks or BACnet networks.

2.5 LOW PROFILE CEILING-CONCEALED DUCTED INDOOR UNIT

A. General:

1. Ceiling-concealed, ducted indoor fan coil. Rear return and fixed horizontal discharge supply. Modulating linear expansion device.

2. Factory assembled, wired and run tested. Factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. Self-diagnostic function, 3-minute time delay mechanism, and auto restart function.
 3. Indoor unit and refrigerant pipes pre-charged with dehydrated air before shipment from factory.
- B. Unit Cabinet:
1. Cabinet space saving, low profile (7-7/8-inches), ceiling-concealed ducted.
- C. Fan:
1. One fan, direct driven by a single motor.
 2. Statically and dynamically balanced. Motor with permanently lubricated bearings.
 3. Minimum of two speed settings.
 4. Fan motor to be thermally protected.
- D. Filter:
1. Standard factory installed return air filter.
- E. Evaporator Coil:
1. Nonferrous construction with smooth plate fins on copper tubing with inner grooves for high efficiency heat exchange.
 2. Brazed tube joints with phos-copper or silver alloy.
 3. Pressure tested at factory.
 4. Condensate pan and drain under coil. Provide with integral condensate pump.
 5. Integral condensate lift mechanism able to raise drain water 21-inches above condensate pan.
 6. Insulated refrigerant lines.
- F. Controls:
1. The unit to have PID controls provided by manufacturer to perform input functions necessary to operate the system. No third party building management system to be required, however, VRV/VRF system to be capable of communicating with third party BMS.
 2. The unit to be compatible with interfacing with connection to LonWorks or BACnet networks.

2.6 CONTROLS FOR VRV SYSTEMS

- A. General:
1. Provide devices required for fully operating system including but not limited to: Remote controllers, schedule timers, system controllers, centralized controllers, integrated web based interface, graphical user workstation, and system integration to Building Management Systems via protocol established in 23 09 00, Instrumentation and Control Performance Specifications or 23 09 33, Electric and Electronic Control System for HVAC.
 2. General Electrical: 24 VDC controller power and communications via common, non-polar communications bus: Main system controller capable of being networked with other system controllers for web based control.
 3. Wiring type: Wiring 2-conductor (16 AWG), twisted shielded pair, and stranded wire.
 4. Install controls in accordance with 23 09 00, Instrumentation and Control Performance Specifications or 23 09 33, Electric and Electronic Control System for HVAC.
- B. Controls Network:
1. Controls Network consists of remote controllers, schedule timers, system controllers, centralized controllers, and integrated web based interface communicating over high-speed communication bus. Controls network support operation monitoring, scheduling, error email distribution, personal browsers, tenant billing, online maintenance support, and integration with Building Management Systems. Provide interfaces to support communication protocols specified in Section 23 09 00.

2. Simple Remote Controller: Simple Remote Controller capable of controlling up to a minimum of 12 indoor units (defined as 1 group). Controller supports temperature display selection of Fahrenheit or Celsius. Controller will allow user to change on/off, mode (cool, heat, auto, dry, and fan), temperature setting, and fan speed setting. Controller able to limit set temperature range from Simple remote controller. Room temperature sensed at either Controller or Indoor Unit dependent on indoor unit dipswitch setting. Controller will display a four-digit error code in event of system abnormality/error.

C. System Integration

1. Control system capable of supporting integration with Building Management Systems (BMS) using protocol specified in Section 23 09 00.
2. Operation and monitoring points include, but are not limited to:
 - a. ON/OFF (setting).
 - b. ON/OFF (status).
 - c. Alarm Sign.
 - d. Error Code.
 - e. Operation Mode (setting).
 - f. Operation Mode (status).
 - g. Fan Speed (setting).
 - h. Fan Speed (status).
 - i. Measured Room Temperature.
 - j. Set Room Temperature.
 - k. Filter Limit Sign.
 - l. Filter Limit Sign Reset.
 - m. Remote Control Operation (ON/OFF).
 - n. Remote Control Operation (Operation Mode).
 - o. Remote Control Operation (Set Temperature).
 - p. Electrical Total Power.
 - q. Communication Status.
 - r. System Forced OFF.
 - s. Forced Thermostat OFF (setting).
 - t. Forced Thermostat OFF (status).
 - u. Compressor Status.
 - v. Indoor Fan Status.
 - w. Heater Operation Status.

END OF SECTION