

unformed surfaces unless otherwise indicated.

- D. All exposed formed concrete surfaces shall have a "smooth-formed finish". All fins shall be removed and shall have a "rubbed" finish. Surface shall be "rubbed" within 48 hours of removing forms, no exceptions.

3.8 MONOLITHIC SLAB FINISHES

- A. General Information (Slabs on Grade): The requirements indicated are based upon the latest FF/FL method. Bids for this work shall reflect these requirements and enforcement thereof can be expected.
- B. Float Finish - Not Critical Floor Tolerance: Apply float finish to monolithic slab surfaces that are to receive trowel finish and other thick finishes as hereinafter specified, and slab surfaces which are to be covered with waterproofing membrane or sand-bed terrazzo, and as otherwise shown on Drawings or in Schedules.
- C. Trowel Finish 1 - Typical Classroom, Corridors, Other Rooms:
 - 1. Specified Overall Value: FF30/FL23
 - 2. Minimum Local Value: FF25/ FL 20
 - 3. Apply trowel finish to slab surfaces that are to be covered with resilient flooring, paint or other thin film finish coating system.
- D. Trowel Finish 3 – Gym, Cafeteria and Stage Floors:
 - 1. Specified Overall Value: FF 50/ FL 30
 - 2. Minimum Local Value: FF40/FL 25
 - 3. Apply trowel finish to slab surfaces that are to be covered with wood flooring, paint, or other thin finish coating system.
- E. Non-slip Broom Finish: Apply non-slip broom finish to exterior concrete with fiber bristle broom, perpendicular to main traffic route. Coordinate required final finish with the Engineer before application.
- F. Modification of Existing Surface:
 - 1. If, in the opinion of the Engineer, or Engineer, or Owner, all or any portion of the substandard work can be repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately undertake the approved repair method.
 - 2. The Contractor shall submit for review and approval a detailed work plan of the proposed repair showing areas to be repaired, method of repair, and time to affect the repair.
 - 3. Repair methods, at the sole discretion of the Engineer or Engineer, may include grinding (floor stoning), planning, re-topping with self-leveling grout or polymer concrete, or any combination of the above.
 - 4. The Engineer, or Engineer, or Owner's Representative maintain the right to require a test repair for review and approval to demonstrate a satisfactory end product. If, in the opinion of the Engineer, Engineer, or Owner's Representative the repair is not satisfactory an alternate method of repair shall be submitted or the defective area shall be replaced.
 - 5. The judgment of the Engineer, or Engineer on the appropriateness of a repair method and its ability to achieve the desired end product shall be final.

6. All repair work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

G. Removal and Replacement:

1. If, in the opinion of the Engineer, or Engineer, all or any portion of the substandard work cannot be satisfactorily repaired without sacrifice to the appearance or serviceability of the area, then the Contractor shall immediately commence to remove and replace the defective work.
2. Replacement section boundaries shall be made to coincide with the test section boundaries as previously defined.
3. Sections requiring replacement shall be removed by saw cutting along the section boundary lines to provide a neat clean joint between new replacement floor and existing floor.
4. The new section shall be reinforced the same as the removed section and doweled into the existing floor as required by the Engineer or Engineer. No existing removed reinforcing steel may be used. All reinforcing steel shall be new steel.
5. Replacement sections may be retested for compliance at the direction of the Engineer or Engineer. Decision shall be final.
6. All replacement work shall be performed at no additional cost to the Owner and with no extension to the construction schedule.

3.9 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as specified to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations. Set anchor bolts for machines and equipment to template at correct elevations, complying with diagrams or templates of manufacturer furnishing machines and equipment.
- D. Grout base plates as indicated, using specified non-metallic, non-shrink grout.

3.10 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. In hot, dry, and windy weather protect concrete from rapid moisture loss before and during finishing operations with an evaporation-control material. Apply according to manufacturer's instructions after screeding and bull floating, but before power floating and trawling.
- B. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing. Weather permitting; keep continuously moist for not less than 72 hours.
- C. Curing Methods: Cure concrete by curing compound, by moist curing, by moisture-retaining

cover curing, or by combining these methods, as specified. Wet cure 7 days minimum at 50 degrees minimum temperature.

D. Provide moisture curing by the following methods:

1. Keep concrete surface continuously wet by covering with water.
2. Use continuous water-fog spray.
3. Cover concrete surface with specified absorptive cover, thoroughly saturate cover with water, and keep continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with a 4-inch lap over adjacent absorptive covers.

E. Provide moisture-retaining cover curing as follows: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

F. Apply curing compound on exposed interior slabs and on exterior slabs, walks, and curbs as follows:

1. Apply curing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours and after surface water sheen has disappeared). Apply uniformly in continuous operation by power spray or roller according to manufacturer's directions. Re-coat areas subjected to heavy rainfall within 3 hours after initial application. Maintain continuity of coating and repair damage during curing period.
2. Use membrane curing compounds that will not affect surfaces to be covered with finish materials applied directly to concrete.

G. Curing Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces, by moist curing with forms in place for the full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.

H. Curing Unformed Surfaces: Cure unformed surfaces, including slabs, floor topping, and other flat surfaces, by applying the appropriate curing method.

1. Final cure concrete surfaces to receive finish flooring with a moisture-retaining cover, unless otherwise directed.

3.11 REMOVING FORMS

A. General: Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete, provided concrete is sufficiently hard to not be damaged by form-removal operations, and provided curing and protection operations are maintained.

B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members.

C. Form-facing material may be removed 24 hours after placement only if shores and other vertical

supports have been arranged to permit removal of form-facing material without loosening or disturbing shores and supports.

3.12 REUSING FORMS

- A. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material will not be acceptable for exposed surfaces. Apply new form-coating compound as specified for new formwork.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use patched forms for exposed concrete surfaces except as acceptable to Engineer.

3.13 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removing forms, when acceptable to Engineer.
- B. Mix dry-pack mortar, consisting of one part portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing.
 - 1. Cut out honeycombs, rock pockets, voids over 1/4 inch in any dimension, and holes left by tie rods and bolts down to solid concrete but in no case to a depth less than 1 inch. Make edges of cuts perpendicular to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with bonding agent. Place patching mortar before bonding agent has dried.
 - 2. For surfaces exposed to view, blend white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- C. Repairing Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes and fill with dry-pack mortar or precast cement cone plugs secured in place with bonding agent.
 - 1. Repair concealed formed surfaces, where possible, containing defects that affect the concrete's durability. If defects cannot be repaired, remove and replace the concrete.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface tolerances specified for each surface and finish. Correct low and high areas as specified. Test unformed surfaces sloped to drain for trueness of slope and smoothness by using a template having the required slope.
 - 1. Repair finished unformed surfaces containing defects that affect the concrete's durability. Surface defects include crazing and cracks in excess of 0.01 inch wide or that penetrate to the reinforcement or completely through non-reinforced sections regardless of width, spalling, popouts, honeycombs, rock pockets, and other objectionable conditions.
 - 2. Correct high areas in unformed surfaces by grinding after concrete has cured at least 14

- days.
3. Correct low areas in unformed surfaces during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete. Proprietary underlayment compounds may be used when acceptable to Engineer.
 4. Repair defective areas, except random cracks and single holes not exceeding 1 inch in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose reinforcing steel with at least 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
- E. Repair isolated random cracks and single holes 1 inch or less in diameter by dry-pack method. Groove top of cracks and cut out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Place dry-pack before bonding agent has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- F. Perform structural repairs with prior approval of Engineer for method and procedure, using specified epoxy adhesive and mortar.
- G. Repair methods not specified above may be used, subject to acceptance of Engineer.

END OF SECTION 03 30 00

Public Works Administration Building Air Conditioning**PROJECT 12259****SECTION 05 50 00
METAL FABRICATIONS****PART 1 GENERAL****1.1 SECTION INCLUDES**

- A. Shop fabricated ferrous metal items.
- B. Shop fabricated aluminum items.

1.2 REFERENCES

- A. AAMA 204 - Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
- B. AAMA 606.1 - Voluntary Guide Specifications and Inspection Methods for Integral Color Anodic Finishes for Architectural Aluminum
- C. AAMA 607.1 - Voluntary Guide Specification and Inspection Methods for Clear Anodic Finishes for Architectural Aluminum
- D. AAMA 608.1 - Voluntary Guide Specifications and Inspection Methods for Electrolytically Deposited Color Anodic Finishes for Architectural Aluminum
- E. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels
- F. ANSI ASC A14.3 - American National Standard for Ladders - Fixed - Safety Requirements
- G. ASTM A36/A36M - Standard Specification for Carbon Structural Steel
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Galvanized) Coatings on Iron and Steel Products
- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- K. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Carbon Steel Plates
- L. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
- M. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Round and Shapes.
- N. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
- O. ASTM B26B26M - Standard Specification for Aluminum-Alloy Sand Castings
- P. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings
- Q. ASTM B177/B177M - Standard Guide for Engineering Chromium Electroplating
- R. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
- S. ASTM B210 - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
- T. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod and Wire
- U. ASTM B221 - Standard Specification for Aluminum-and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes
- V. AWS A2.4 - Standard Symbols for Welding, Brazing, Nondestructive Examination
- W. AWS D1.1/D1.1M - Structural Welding Code Bundled Set B
- X. FBC - Florida Building Code
- Y. SSPC - Steel Structure Painting Council - Steel Structures Painting Council

1.3 SUBMITTALS FOR REVIEW

- A. Section 01 33 00 - Submittals Procedures
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size, and type of fasteners, and accessories.

METAL FABRICATIONS

Public Works Administration Building Air Conditioning**PROJECT 12259**

1. Include erection drawings, elevations, and details.
 - C. Indicate welded connections using standard AWS A2.0 welding symbols.
 1. Indicate net weld lengths.
- 1.4 QUALIFICATIONS
- A. Prepare Shop Drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the State of Florida.
 - B. Welders' Certificates: Submit under provisions of Section 01 33 00, certifying welders employed on the Work, verifying AWS qualification within the previous 12-months.

PART 2 PRODUCTS**2.1 MATERIALS - STEEL**

- A. Steel Sections: ASTM A36/A36M
- B. Steel Tubing: ASTM A500/A500M, Grade B
- C. Plates: ASTM A283/A283M
- D. Pipe: ASTM A53/A53M, Type E or S, Grade B, Schedule 40 minimum
- E. Bolts, Nuts, and Washers: ASTM A325 or A307 galvanized to ASTM A153/A153M for galvanized components
- F. Welding Materials: AWS D1.1; type required for welded materials
- G. Ladders: ANSI A14.3
- H. Shop and Touch-Up Primer: SSPC 15, Type 1, red oxide
- I. Touch-Up Primer for Galvanized Surfaces: SSPC 20, Type I Inorganic zinc rich

2.2 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B221, Alloy 6063, Temper T5
- B. Sheet Aluminum: ASTM B209, Alloy, Temper
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210, Alloy 6063, Temper T6
- D. Aluminum-Alloy Bars: ASTM B211, Alloy 6063, Temper T6
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M, Alloy
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M, Alloy
- G. Bolts, Nuts and Washers: Stainless steel
- H. Welding Materials: AWS D1.1/D1.1M; type required for welded materials

2.3 FABRICATION

- A. Fit and shop assemble in largest practical sections for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Continuously seal joined members by continuous welds.
- D. Grind exposed joints flush and smooth with adjacent finish surface.
 1. Make exposed joints butt tight, flush, and hairline.
 2. Ease exposed edges to small uniform radius.
- E. Exposed Mechanical Fastenings: Provide flush countersunk screws or bolts unobtrusively located consistent with design of component except as noted otherwise
- F. Supply components required for anchorage of fabrications.
 1. Fabricate anchors and related components of same material and finish as fabrication, except as noted otherwise.

2.4 FABRICATION TOLERANCES

- A. Square: 1/8" maximum difference in diagonal measurements.
- B. Maximum Offset between Faces: 1/16"
- C. Maximum Misalignment of Adjacent Members: 1/16"
- D. Maximum Bow: 1/8" in 48"
- E. Maximum Deviation from Plane: 1/16" in 48"

METAL FABRICATIONS

Public Works Administration Building Air Conditioning**PROJECT 12259****2.5 FINISHES - STEEL**

- A. Prepare surfaces to be primed in accordance with SSPC SP 2.
- B. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- C. Do not prime surfaces in where field welding is required.
- D. Prime paint items with one coat.
- E. Structural Steel Members:
 - 1. Galvanize after fabrication to ASTM A123/A123M.
 - 2. Provide minimum 1.25 oz/sq ft galvanized coating.
- F. Non-structural Items:
 - 1. Galvanize after fabrication to ASTM A123/A123M.
 - 2. Provide minimum 1.25 oz/sq ft galvanized coating.
- G. Chrome Plating: ASTM B177/B177M, weight, nickel-chromium alloy, satin finish.

2.6 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Exterior, hard coat, two step anodized to clear color to 0.0007" thickness organic coating to color selected.
- B. Interior Aluminum Surfaces: Interior, hard coat, two-step anodized to clear color to 0.0007" thickness organic coating to color selected.
- C. Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.

PART 3 EXECUTION**3.1 EXAMINATION**

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

3.2 PREPARATION

- A. Clean and strip primed steel items to bare metal and aluminum where site welding is required.
- B. Supply required items for casting into concrete or embedded in masonry with setting templates to appropriate sections.

3.3 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components indicated on shop drawings.
- D. Perform field welding in accordance with AWS D1.1.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions and surfaces not shop primed or galvanized, except surfaces to be in contact with concrete
- G. Provide isolation coatings where dissimilar metals are in contact or where aluminum is in contact with concrete.

3.4 ERECTION TOLERANCES

- A. Maximum Variation from Plumb: ¼" per story, non-cumulative
- B. Maximum Offset from True Alignment: ¼"
- C. Maximum Out-of-Position: ¼"

END OF SECTION

Public Works Administration Building Air Conditioning**PROJECT 12259****SECTION 07 21 00 - THERMAL INSULATION****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Glass-fiber blanket insulation.
- B. Related Sections:
 - 1. Section 09 22 16 "Non-Structural Metal Framing" for metal-framed assemblies.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. LEED Submittals:
 - 1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating cost for each product having recycled content.

1.4 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for each product.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS**2.1 GLASS-FIBER BLANKET INSULATION**

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. CertainTeed Corporation.
 - 2. Guardian Building Products, Inc.
 - 3. Johns Manville.
 - 4. Knauf Insulation.
 - 5. Owens Corning.

THERMAL INSULATION

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. Recycled Content: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Unfaced, Glass-Fiber Blanket Insulation: ASTM C 665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.
 - 1. Thickness to match non-structural metal framing member or a minimum of 3.5" – R11.
- D. Sustainability Requirements: Provide glass-fiber blanket insulation as follows:
 - 1. Free of Formaldehyde: Insulation manufactured with 100 percent acrylic binders and no formaldehyde.
 - 2. Low Emitting: Insulation tested according to ASTM D 5116 and shown to emit less than 0.05-ppm formaldehyde.

2.2 INSULATION FASTENERS

- A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of specified thickness securely in position indicated with self-locking washer in place.
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [AGM Industries, Inc.](#); Series T TACTOO Insul-Hangers.
 - b. [Gemco](#); Spindle Type.
 - 2. Plate: Perforated, galvanized carbon-steel sheet, 0.030 inch (0.762 mm) thick by 2 inches (50 mm) square.
 - 3. 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- (0.41-mm-) 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 (38 mm) square or in diameter.
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [AGM Industries, Inc.](#); RC150 or SC150.
 - b. [Gemco](#); R-150 or S-150.
 - 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in above ceiling areas.
- C. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.
 - 1. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [AGM Industries, Inc.](#); TACTOO Adhesive.
 - b. [Gemco](#); Tuff Bond Hanger Adhesive.

PART 3 - EXECUTION**3.1 PREPARATION**

- A. Clean substrates of substances that are harmful to insulation or that interfere with insulation attachment.

THERMAL INSULATION**072100-2**

CAM 21-0549

Exhibit 1B

Page 10 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259****3.2 INSTALLATION, GENERAL**

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

3.3 INSTALLATION OF INSULATION FOR FRAMED CONSTRUCTION

- A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.
- B. Glass-Fiber Blanket Insulation: Install in cavities formed by framing members according to the following requirements:
 - 1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill the cavities, provide lengths that will produce a snug fit between ends.
 - 2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
 - 3. Maintain 3-inch (76-mm) clearance of insulation around recessed lighting fixtures not rated for or protected from contact with insulation.
 - 4. For metal-framed wall cavities where cavity heights exceed 96 inches (2438 mm), support unfaced blankets mechanically.
- C. Miscellaneous Voids: Install insulation in miscellaneous voids and cavity spaces where required to prevent gaps in insulation using the following materials:

3.4 INSTALLATION OF INSULATION FOR CONCRETE SUBSTRATES

- A. Install insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:
 - 1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
 - 2. After adhesive has dried, install insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.
 - 3. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.5 PROTECTION

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

END OF SECTION 07 21 00

THERMAL INSULATION

Public Works Administration Building Air Conditioning**PROJECT 12259****SECTION 07 62 00 - SHEET METAL FLASHING AND TRIM****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Formed Products:
 - a. Formed equipment support flashing.
- B. Related Sections:
 - 1. Section 06 10 35 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
 - 2. Section 07 54 00 "Thermoplastic Membrane Roofing" for installing sheet metal flashing and trim integral with membrane roofing.
 - 3. Section 07 71 00 "Roof Specialties" for manufactured roof specialties not part of sheet metal flashing and trim.
 - 4. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.

1.3 PERFORMANCE REQUIREMENTS

- A. General: Sheet metal flashing and trim assemblies as indicated shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Completed sheet metal flashing and trim shall not rattle, leak, or loosen, and shall remain watertight.
- B. Thermal Movements: Provide sheet metal flashing and trim that allows for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change (Range): 20 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each manufactured product and accessory.
- B. Shop Drawings: Show fabrication and installation layouts of sheet metal flashing and trim, including plans, elevations, expansion-joint locations, and keyed details. Distinguish between shop- and field-assembled work. Include the following:
 - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Details of termination points and assemblies, including fixed points.
 - 5. Details of special conditions.
 - 6. Details of connections to adjoining work.
 - 7. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches (1:5).

SHEET METAL FLASHING AND TRIM**076200-1**

CAM 21-0549

Exhibit 1B

Page 12 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:
 - 1. Sheet Metal Flashing: 12 inches (300 mm) long by actual width of unit, including finished seam and in required profile. Include fasteners, cleats, clips, closures, and other attachments.
 - 2. Accessories and Miscellaneous Materials: Full-size Sample.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified fabricator.
- B. Research/Evaluation Reports: For all flashing systems, from the Florida Department of Community Affairs holding a current Florida Product Approval.
- C. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For sheet metal flashing, trim, and accessories to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate sheet metal flashing and trim similar to that required for this Project and whose products have a record of successful in-service performance.
- B. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" unless more stringent requirements are specified or shown on Drawings.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
 - 2. Review methods and procedures related to sheet metal flashing and trim.
 - 3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
 - 4. Review special roof details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect sheet metal flashing.
 - 5. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage. Store sheet metal flashing and trim materials away from uncured concrete and masonry.
- B. Protect strippable protective covering on sheet metal flashing and trim from exposure to sunlight and high humidity, except to the extent necessary for the period of sheet metal flashing and trim installation.

PART 2 - PRODUCTS**2.1 SHEET METALS**

- A. General: Protect mechanical and other finishes on exposed surfaces from damage by applying a strippable, temporary protective film before shipping.

SHEET METAL FLASHING AND TRIM**076200-2**

CAM 21-0549

Exhibit 1B

Page 13 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper as required to suit forming operations and performance required.
 - 1. Clear Anodic Finish, Coil Coated: AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

2.2 UNDERLAYMENT MATERIALS

- A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).
 - 3. **Products:** Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
 - a. [Carlisle Coatings & Waterproofing Inc.](#); CCW WIP 300HT.
 - b. [Grace Construction Products, a unit of W. R. Grace & Co.](#); Ultra.
 - c. [Henry Company](#); Blueskin PE200 HT.
 - d. [Metal-Fab Manufacturing, LLC](#); MetShield.
 - e. [Owens Corning](#); WeatherLock Metal High Temperature Underlayment.

2.3 MISCELLANEOUS MATERIALS

- A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation and recommended by manufacturer of primary sheet metal unless otherwise indicated.
- B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads and recommended by manufacturer of primary sheet metal.
 - 1. General: Blind fasteners or self-drilling screws, gasketed, with hex-washer head.
 - a. Exposed Fasteners: Heads matching color of sheet metal using plastic caps or factory-applied coating.
 - b. Blind Fasteners: High-strength stainless-steel rivets suitable for metal being fastened.
 - 2. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.
- C. Solder:
 - 1. For Stainless Steel: ASTM B 32, Grade Sn60, with an acid flux of type recommended by stainless-steel sheet manufacturer.
- D. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
- E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- F. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.
- G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

SHEET METAL FLASHING AND TRIM**076200-3**

CAM 21-0549

Exhibit 1B

Page 14 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259****2.4 FABRICATION, GENERAL**

- A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, geometry, metal thickness, and other characteristics of item indicated. Fabricate items at the shop to greatest extent possible.
 - 1. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.
 - 2. Obtain field measurements for accurate fit before shop fabrication.
 - 3. Form sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
 - 4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces exposed to view.
- B. Fabrication Tolerances: Fabricate sheet metal flashing and trim that is capable of installation to a tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- C. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant.
- D. Expansion Provisions: Where lapped expansion provisions cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with butyl sealant concealed within joints.
- E. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
- F. Seams: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with elastomeric sealant unless otherwise recommended by sealant manufacturer for intended use. Rivet joints where necessary for strength.
- G. Do not use graphite pencils to mark metal surfaces.

2.5 MISCELLANEOUS SHEET METAL FABRICATIONS

- A. Equipment Support Flashing: Fabricate from the following materials:
 - 1. Stainless Steel: 0.019 inch (0.48 mm) thick.

PART 3 - EXECUTION**3.1 EXAMINATION**

- A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of the Work.
 - 1. Verify compliance with requirements for installation tolerances of substrates.
 - 2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
- B. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

- A. General: Install underlayment as indicated on Drawings.

SHEET METAL FLASHING AND TRIM**076200-4**

CAM 21-0549

Exhibit 1B

Page 15 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. Self-Adhering Sheet Underlayment: Install self-adhering sheet underlayment, wrinkle free. Apply primer if required by underlayment manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation; use primer rather than nails for installing underlayment at low temperatures. Apply in shingle fashion to shed water, with end laps of not less than 6 inches (150 mm) staggered 24 inches (600 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

3.3 INSTALLATION, GENERAL

- A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.
1. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.
 2. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.
 3. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.
 4. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
 5. Install sealant tape where indicated.
 6. Torch cutting of sheet metal flashing and trim is not permitted.
 7. Do not use graphite pencils to mark metal surfaces.
- B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by SMACNA.
1. Coat back side of stainless-steel sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
 2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene sheet.
- C. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m)] with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with sealant concealed within joints.
- D. Fastener Sizes: Use fasteners of sizes that will penetrate wood blocking not less than 3/4 inch (19 mm) for wood screws as recommended by fastener manufacturer to achieve maximum pull-out resistance.
- E. Seal joints as shown and as required for watertight construction.
1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
 2. Prepare joints and apply sealants to comply with requirements in Section 07 92 00 "Joint Sealants."

SHEET METAL FLASHING AND TRIM**076200-5**

CAM 21-0549

Exhibit 1B

Page 16 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm), except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 2. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.

3.4 MISCELLANEOUS FLASHING INSTALLATION

- A. Equipment Support Flashing: Coordinate installation of equipment support flashing with installation of roofing and equipment. Weld or seal flashing with elastomeric sealant to equipment support member.

3.5 ERECTION TOLERANCES

- A. Installation Tolerances: Shim and align sheet metal flashing and trim within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.

3.6 CLEANING AND PROTECTION

- A. Clean exposed metal surfaces.
- B. Clean and neutralize flux materials. Clean off excess solder.
- C. Clean off excess sealants.
- D. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, remove unused materials and clean finished surfaces. Maintain in a clean condition during construction.
- E. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 62 00

**SECTION 08 90 00
LOUVERS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fixed, extruded-aluminum louvers.
- B. Related Sections:
 - 1. Division 04 Section "Unit Masonry" for building wall vents (brick vents) into masonry.
 - 2. Division 09 Section "Exterior Painting" for field painting louvers.
 - 3. Division 23 Sections for louvers that are a part of mechanical equipment.

1.3 DEFINITIONS

- A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.
- B. Horizontal Louver: Louver with horizontal blades; i.e., the axes of the blades are horizontal.
- C. Vertical Louver: Louver with vertical blades; i.e., the axes of the blades are vertical.
- D. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.
- E. Storm-Resistant Louver: Louver that provides specified wind-driven rain performance, as determined by testing according to AMCA 500-L.

1.4 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design louvers, including comprehensive engineering analysis by a qualified professional engineer, using structural performance requirements and design criteria indicated.
- B. Structural Performance: Louvers shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louver components, noise or metal fatigue caused by louver blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - 1. Wind Loads: Determine loads based on pressures as indicated on Drawings.

- C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes, without buckling, opening of joints, overstressing of components, failure of connections, or other detrimental effects.
 - 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Louver Performance Ratings: Provide louvers complying with requirements specified, as demonstrated by testing manufacturer's stock units identical to those provided, except for length and width according to AMCA 500-L.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
 - 1. For louvers specified to bear AMCA seal, include printed catalog pages showing specified models with appropriate AMCA Certified Ratings Seals.
- B. Shop Drawings: For louvers and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - 1. Show weep paths, gaskets, flashing, sealant, and other means of preventing water intrusion.
 - 2. Show mullion profiles and locations.
- C. Samples for Initial Selection: For units with factory-applied color finishes.
- D. Samples for Verification: For each type of metal finish required.
- E. Delegated-Design Submittal: For louvers indicated to comply with structural[**and seismic**] performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

- A. Product Test Reports: Based on evaluation of comprehensive tests performed according to AMCA 500-L by a qualified testing agency or by manufacturer and witnessed by a qualified testing agency, for each type of louver and showing compliance with performance requirements specified.

1.7 QUALITY ASSURANCE

- A. Source Limitations: Obtain louvers and vents from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.
- B. Welding: Qualify procedures and personnel according to the following:
 - 1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
 - 2. AWS D1.3, "Structural Welding Code - Sheet Steel."
 - 3. AWS D1.6, "Structural Welding Code - Stainless Steel."
- C. SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

- D. Louvers licensed to bear AMCA Certified Ratings Seal. Ratings based on tests and procedures performed in accordance with AMCA 511 and comply with AMCA Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance and water penetration ratings.
- E. Louvers approved by the Miami-Dade County BCCO for use in open structures that have the ability to drain water that may penetrate. Approval based on tests and procedures performed in accordance with BCCO test protocols PA-201, PA-202 and PA-203.

1.8 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Aluminum Extrusions: **ASTM B 221 (ASTM B 221M)**, Alloy 6063-T5, T-52, or T6.
- B. Aluminum Sheet: **ASTM B 209 (ASTM B 209M)**, Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- C. Aluminum Castings: ASTM B 26/B 26M, Alloy 319.
- D. Fasteners: Use types and sizes to suit unit installation conditions.
 - 1. Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - 2. For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - 3. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - 4. For fastening stainless steel, use 300 series stainless-steel fasteners.
 - 5. For color-finished louvers, use fasteners with heads that match color of louvers.
- E. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.
- F. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.2 FABRICATION, GENERAL

- A. Assemble louvers in factory to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- B. Vertical Assemblies: Where height of louver units exceeds fabrication and handling limitations, fabricate units to permit field-bolted assembly with close-fitting joints in jambs and mullions, reinforced with splice plates.

- C. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- D. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.
 - 1. Frame Type: Exterior flange and interior flange unless otherwise indicated.
- E. Include supports, anchorages, and accessories required for complete assembly.
- F. Provide vertical mullions of type and at spacings indicated, but not more than recommended by manufacturer, or **72 inches (1830 mm)** o.c., whichever is less.
 - 1. Semirecessed Mullions: Where indicated, provide mullions partly recessed behind louver blades so louver blades appear continuous. Where length of louver exceeds fabrication and handling limitations, fabricate with interlocking split mullions and close-fitting blade splices designed to permit expansion and contraction.

2.3 FIXED, EXTRUDED-ALUMINUM LOUVERS

- A. Horizontal, Drainable-Blade Louver:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Greenheck Fan Corporation.
 - b. Ruskin Company; Tomkins PLC.
 - 2. Louver Depth: Maximum **6 inches (150 mm)**.
 - 3. Frame and Blade Nominal Thickness: Not less than **0.080 inch (2.03 mm)** for blades and **0.080 inch (2.03 mm)** for frames.
 - 4. Mullion Type: Exposed.
 - 5. Louver Performance Ratings:
 - a. Point of Beginning Water Penetration: Not less than **1100 fpm (5.6 m/s)**.
 - b. Air Performance: Not more than **0.10-inch wg (25-Pa)** static pressure drop at **700-fpm (3.6-m/s)** free-area intake velocity.
 - 6. AMCA Seal: Mark units with AMCA Certified Ratings Seal.

2.4 LOUVER SCREENS

- A. General: Provide screen at each exterior louver.
 - 1. Screen Location for Fixed Louvers: Interior face.
 - 2. Screening Type: Bird screening for all intake louvers. Bird and insect screening for exhaust louvers.
- B. Secure screen frames to louver frames with machine screws with heads finished to match louver, spaced a maximum of **6 inches (150 mm)** from each corner and at **12 inches (300 mm)** o.c.
- C. Louver Screen Frames: Fabricate with mitered corners to louver sizes indicated.
 - 1. Metal: Same kind and form of metal as indicated for louver to which screens are attached. Screens shall be accessible from the interior for removal.
 - 2. Finish: Same finish as louver frames to which louver screens are attached.
 - 3. Type: Rewirable frames with a driven spline or insert.
- D. Louver Screening for Aluminum Louvers:

1. Bird Screening: Aluminum, 1/2-inch- (13-mm-) square mesh, 0.063-inch (1.60-mm) wire.
2. Insect Screening: Aluminum, 18-by-16 (1.4-by-1.6-mm) mesh, 0.012-inch (0.30-mm) wire.

2.5 FINISHES, GENERAL

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

2.6 ALUMINUM FINISHES

- A. Finish louvers after assembly.
- B. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- A. Locate and place louvers and vents level, plumb, and at indicated alignment with adjacent work.
- B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- C. Form closely fitted joints with exposed connections accurately located and secured.
- D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- E. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.
- F. Protect unpainted galvanized and nonferrous-metal surfaces that will be in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy

coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

- G. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Division 07 Section "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

- A. Clean exposed surfaces of louvers and vents that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- C. Restore louvers and vents damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.
 - 1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 089000

SECTION 92900**GYPSUM DRYWALL SYSTEMS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Gypsum wallboard construction as indicated on drawings including metal stud partition framing members; fire resistant rated; metal wall furring; suspended metal ceiling furring; gypsum wallboard, gypsum board wall system for the enclosure of shafts; moisture resistant gypsum board, and tile backer board screw fastened to metal framing and furring; and necessary accessories indicated on drawings and specified in this section.

1.02 RELATED SECTIONS

- A. 01330 - Submittal Procedures
- B. 02070 - Selective Demolition.
- C. 06100 - Rough Carpentry (Wood Furring, where indicated; Grounds and Blocking).
- D. 09300 - Ceramic Tile.
- E. 09900 - Painting.

1.03 SUBMITTALS

- A. Submit properly identified product data including material specifications and printed installation directions for system.
- B. Manufacturer's U.L. design for each item of construction, where fire rated partitions, enclosures of shafts and ceilings are indicated.

1.04 QUALITY ASSURANCE

- A. Unless otherwise specified, comply with applicable requirements of governing codes and authorities and ANSI A97.2.
- B. Comply with fire-resistance ratings as required by governing authorities and codes. Materials must be listed by Underwriters' Laboratories or tested in accord with ASTM E119.
- C. All components of gypsum board systems shall be by one manufacturer or compatible.
- D. All finish wallboard work will be subject to inspection using a lighting level of not less than fifty foot candles at surface of gypsum wallboard. Surfaces judged by Architect to be unsuitable for finishing, whether or not finishes have been applied, will be rejected.

1. Architect will direct repair or replacement of rejected work.

1.05 ENVIRONMENTAL CONDITIONS

- A. Proceed with installation of gypsum board materials only after building is weather-tight.
- B. Maintain temperature in areas receiving gypsum board materials between 50 degrees and 90 degrees F. during and subsequent to installation and provide adequate ventilation for drying joint and fastening treatment compounds.
- C. Comply with ASTM C840 requirements for shaft wall system.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Following manufacturers are acceptable subject to compliance with specifications:
 1. Georgia - Pacific Corp.
 2. National Gypsum Co.
 3. United States Gypsum Co.

2.02 METAL STUD FRAMING MEMBERS

- A. Metal Studs: ASTM C645; screw type, roll formed galvanized steel, 25 gage and 20 gage as indicated or as specified, depths as indicated for new work and as required to match existing for remodeling work.
- B. Floor and Ceiling Runners: 25 gage galvanized steel; width as required to suit screw studs. Ceiling runners for partitions terminating at underside of structural deck shall be long leg type 1-1/4 inch flange depth minimum. Where indicated, provide custom fabricated floor runners of special height as indicated and of width as required to suit screw studs.
- C. Shaft wall I-Stud (1/2 inch less than ceiling height).

2.03 METAL WALL FURRING (For insulated walls)

- A. ZEE Furring: (25 gage) (20 gage) galvanized steel furring, with 7/8 inch minimum wall flange by (1) inch depth required to fit wall insulation indicated.

2.04 METAL FRAMING FOR SUSPENDED CEILINGS AND SOFFITS

- A. Ceiling Hanger Wire Tie Inserts For Cast-In-Place Concrete Slabs:
 1. Heckman Building Products Inc.: No. 461, of galvanized steel.
- B. Ceiling Hanger Wire Tie Concrete Expansion Bolts For Existing Concrete Slabs:

1. ITW Ramset/Redhead: No. TW-1614 drilled in sleeve type.
 2. Star: No. 3411-3 self drilling type.
 3. Phillips: T-32.
- C. Hangers: Galvanized, annealed, pre-straightened steel wire, No. 8 gage where supporting up to 12.5 square feet of ceiling, and No. 6 gage where supporting up to 16 square feet of ceiling.
- D. Channel Tie Wire: 16 gage galvanized soft annealed steel wire.
- E. Channel Clips: Galvanized wire designed to attach furring channels to 1-1/2 inch main runners.
- F. Main Runners: Cold-rolled painted steel channels, 1-1/2 inch x .475 pounds per foot and 2 inch x 1.26 pounds per foot as required by Table 2.
- G. Cross Furring: ASTM C645, 25 gage hat shaped galvanized steel furring channel; 7/8 inch deep x 1 3/8 inch face width.
- H. Metal Screw Stud Furring: ASTM C645; screw type, roll formed galvanized steel, 25 gage of depths as indicated or as required by Table 2.

2.05 GYPSUM BOARD ACCESSORIES

- A. Corner Beads: "Dur-A-Bead" No. 101 manufactured by United States Gypsum; heavy duty, electro-galvanized steel; 1 inch x 1 inch.
- B. Casing Beads: No. 200 Series manufactured by United States Gypsum; roll formed electro-galvanized steel.
- C. Control Joints: No. 093 of roll formed zinc, manufactured by United States Gypsum, with tape protected 1/4 inch wide x 7/16 inch deep opening.

2.06 GYPSUM BOARD

- A. Width 48 inches unless otherwise indicated; thicknesses as indicated or as required to match existing for remodeling work; lengths as great as practicable to minimize joints; in accord with ASTM C36 and the following:
- B. Regular Gypsum Board: Paper faced surface suitable to receive decorative finish with long edges tapered.
- C. Fire Rated Gypsum Board: Type X, with specially formulated mineral core and treated paper face, and with long edges tapered.
- D. Gypsum shaft liner (1 inch less than ceiling height).

- E. Gypsum Backing Board (For multi layer fire rated use): ASTM C442, or ASTM C36, Type X, with specially formulated mineral core and treated paper face.
- F. Water Resistant Gypsum Board: Multi layered chemically treated face and back paper and asphalt composition core in accord with ASTM C630 with long edges tapered.
- G. Tile Backer Board At Tiled Walls bath tub and shower areas): Portland cement type with light weight aggregate, 7/16 inch or 1/2 inch thick by 36 inches wide, lengths as great as practicable to minimize joints.
 - 1. Acceptable Manufacturers:
 - a. United States Gypsum: "Durock".
 - b. Modulars, Inc., P.O. Box 216, Hamilton, Ohio 45012: "Wonder-Board".
 - c. Georgia Pacific Corp.: "Dens-Shield".

2.07 FASTENERS

- A. Gypsum Board Screws: No. 6 self-drilling, cross slot countersunk bugle head, zinc plated, 1 inch long for single gypsum board layer applied to metal studs, and metal furring and not less than 1-5/8 inch long for double layer gypsum board applied to metal studs. Provide 1-1/4 inch screws for gypsum board applied to wood furring or blocking.
- B. Runner and Metal Furring Fasteners To Concrete: Zinc plated hardened steel stub nails.
- C. Runner and Metal Furring Fasteners To Metal Decks: No. 6 self drilling, cross slot pan head, zinc plated, 3/8 inch or 1/2 inch long, or as required.
- D. Stud and Door Frame Screws: No. 6 self drilling, cross slot pan head, zinc plated, 3/8 inch or 1/2 inch long, or as required.
- E. Shaft wall accessories:
 - 1. Rolled steel angle, 2" X 2" by 20 gage.
 - 2. Screws: comply with ASTM C954 or ASTM C1002 or both with heads, threads, points, and finish as recommended by the manufacturer.
- F. Staples for Gypsum Board Accessories: Zinc plated; length as required.

2.08 JOINT TREATMENT MATERIALS

- A. Tape and joint compound for embedding and fill coat application and finishing in accord with ASTM C475 and ASTM C840 for shaft wall, ready mixed.

2.09 SOUND ATTENUATION BLANKETS

- A. In accord with Fed. Spec. HH-I-521F, Type 1, Class A; thickness as indicated; "Thermafiber" manufactured by U.S. Gypsum Co.; mineral wool blankets or batts

manufactured by National Gypsum Co.; Fiberglass blankets manufactured by Owens-Corning Fiberglass Corp.

2.10 BUTYL ACOUSTICAL SEALER TAPE

- A. 1/16 inch by 2 inch, Tremco TAT-1 or 3M Brand.

2.11 ACOUSTICAL SEALANT

- A. Acrylic or vinyl emulsion type, U.S. Gypsum Acoustical Sealant, or accepted equivalent.

PART 3 EXECUTION

3.01 GENERAL

- A. Install gypsum board systems in strict accord with manufacturer's published installation directions, and as specified herein.

3.02 INSTALLATION OF METAL FRAMING FOR GYPSUM BOARD PARTITIONS

- A. Install floor and ceiling runners as required; do not miter at corners.
- B. Install steel stud members 16 inches o.c., plumb, level, true to line, and secured with proper fasteners in accord with manufacturer's instructions unless otherwise specified.
- C. Terminate partitions at underside of decks or existing framing, unless otherwise indicated.
- D. Where partitions terminate at underside of structural deck, install long leg type ceiling runners leaving 1/2 inch space between top of stud and web of ceiling runner to allow for overhead deck deflection. Do not screw studs to ceiling runners where partition extends to underside of structural decks.
- E. Secure ceiling runners to concrete structure with hardened stub nails or power driven fasteners at 24 inches on center. Secure ceiling runners to underside of metal decks with self drilling sheet metal screws at 24 inches o.c.
- F. Provide additional studs to support inside corners at partition intersections and corners, and to support outside corners, terminations of partitions and both sides of control joints. Provide not less than 3 studs at partition external corners and intersections.
- G. Provide 20 gage metal studs at door jambs and at partitions supporting heavy loads such as shelving, wall cabinets, and plumbing fixtures. Provide (25) (20) gage studs at other locations.

- H. Coordinate frame openings with hollow metal frames. Provide 20 gage metal studs on each side of door frame openings extended to overhead structure. Framing across top of door frames shall be made of standard floor and ceiling runner with flanges cut and bent 90 degrees at each end. Install short lengths of studs vertically 16 inches o.c. above door frames, with each flange of each stud secured to top and bottom runners. Provide diagonal stud braces in stud panels over openings exceeding 4 feet wide. Fit diagonal stud braces between top and bottom runners and secure each flange at each end to runners.
- I. Provide all holes, cut outs and notches in framing members for proper installation of electrical and mechanical items. Provide stud framing fastened in partitions as required for support of electrical boxes, telephone boxes, lights, access doors, and other attached or recessed equipment. Provide all stud and ceiling runner reinforcing or additional studs as required to provide straight, plumb and safe partitions, free from weakness. Where studs are cut for pipe, conduits, and other work, reinforce partitions in accord with manufacturer's directions and details.
- J. Where chase walls are indicated thicker than nominal stud depth, provide two rows of metal studs. Studs to be spaced 16 inches o.c. to provide chase wall width desired or as required to accommodate pipes and recessed accessories indicated. Brace each row of studs together with horizontal metal stud sections spaced 24 inches o.c. maximum, attached to each vertical stud.

3.03 INSTALLATION OF METAL SUSPENSION SYSTEM FOR CEILINGS AND SOFFITS A.

TABLE 1 - SPANS AND SPACINGS OF MAIN RUNNERS

<u>Minimum Size and Type</u>	<u>or Supports</u>	<u>Spacing of Runners</u>
1 1/2 in.-0.475 lb. per ft., Cold rolled channel	3 ft. 0 in.	5 ft. 0 in.
1 1/2 in.-0.475 lb. per ft., Cold rolled channel	3 ft. 6 in.	4 ft. 6 in.
1 1/2 in.-0.475 lb. per ft., Cold rolled channel	4 ft. 0 in.	4 ft. 0 in.
1 1/2 in.-1.12 lb. per ft., Hot rolled channel	4 ft. 0 in.	6 ft. 0 in.
2 in.-1.26 lb. per ft., Hot rolled channel	3 ft. 6 in.	8 ft. 0 in.

B. TABLE 2 - SPANS AND SPACINGS OF FURRING MEMBERS

FURRING MEMBER	FURRING MEMBER SPACING		
Resilient Furring Channel	2'0"	2'0"	2'0"
Furring Channel	4'0"	4'6"	5'0"
1-5/8" Screw Studs	5'0"	5'6"	6'0"
2-1/2" Screw Studs	6'0"	6'6"	7'0"
3-5/8" Screw Studs	8'0"	8'6"	9'0"
4" Screw Studs	8'6"	9'0"	9'6"
6" Screw Studs	8'6"	9'0"	9'6"

C. Hangers:

1. Location and Spacing: Locate hangers plumb in relation to main runners and avoid contact with insulation covering ducts and pipes. Do not pass hangers through ducts. Space hangers in accord with Table 1. Alter spacing of hangers or provide double hangers splayed to avoid ducts and other obstructions but do not exceed maximum allowable ceiling area to be supported by each hanger. Offset horizontal forces of splayed hangers by counter splaying bracing or other suitable means.
2. Provide extra hangers within 6 inches of ends of main runners, to support light fixtures and as required to support diffusers, grilles, access panels and other items resting in or on the ceilings. At control and expansion joints, provide extra hangers as required to support discontinuous runners.

D. Main Runners: Suspend main runners on hanger wires, level and true. Size and spacing of main runners shall be in accord with Table 1. Saddle tie main runners to hanger wires. Locate main runners within 6 inches of parallel walls to provide support for cross furring. Splice main runners by lapping 12 inches and wire tying each end of splice with two double strands of 16 gage wire.

E. Furring: Provide standard metal furring or metal screw stud type furring channels of sizes and spacings indicated in Table 2. Attach furring to main runners by saddle tying to main runners with two strands of No. 16 gage wire, or by suitable wire clips. Splice screw stud type furring channels by lapping 8 inches and secure with pan head sheet metal screws.

F. Do not abut runners or furring into masonry or concrete construction; allow 1 inch clearance, minimum between such construction and ends of runners or furring.

G. Install suspension system to required plane within + 1/8 inch in 12 feet.

H. Maximum Allowable Ceiling Deflection: 1/240.

- I. Grillage Reinforcing: At light fixtures, access doors, and other ceiling openings that interrupt furring, provide additional furring reinforcing to restore grillage strength. Provide furring members at perimeters of ceiling openings.
- J. Access Doors: Install access doors furnished under other trades. Provide hanger wire supports at corners of access doors sized 16 inches or larger.

3.04 INSTALLATION OF GYPSUM BOARD

- A. General: Cut and fit gypsum board by scoring and breaking, or by sawing, working from face side. Smooth cut edges and ends of gypsum board to achieve neat joining. Where gypsum board meets projecting surfaces, scribe and cut. Remove cracked, broken or otherwise damaged boards and replace with new materials.
- B. Walls Partitions and Columns: Apply gypsum board with long dimension parallel to metal stud framing members or metal furring channels. Except for column edges, lay out gypsum board ends and edges to occur over studs or channels, horizontally and vertically. Use gypsum board of maximum practical length to minimize joints. Joints to be neatly fitted and staggered on opposite sides of studs. Cut gypsum board to fit tight to penetrations and abutting items. Allow 1/4 inch clear space at floor to prevent wicking. Reduce wicking gap to 1/8 inch at sound rated partitions. Extend gypsum board upward to structural slabs. Cover exposed gypsum board end joints at masonry walls with metal trim strip against a continuous bead of calking.
- C. Ceilings: Apply gypsum board to the ceiling with long dimension at right angles to the furring members. Gypsum board may be applied with long dimension parallel to furring members that are spaced 16 inches o.c. when attachment members are provided at end joints.
- D. Fire Rated Construction: Where fire rated construction is indicated, it shall be in accord with approved manufacturer's U.L. or F.M. fire rated installation directions.
- E. Accessories and Trim: Install accessories and trim as follows:
 - 1. Corner Beads: Install specified corner beads from floor to ceiling line on all external gypsum board surfaces.
 - 2. Casing Beads: Install specified casing beads in all other locations where gypsum board abuts another material and to exposed gypsum board edges.
 - 3. Fasten above accessories and trim with staples or crimps in accord with manufacturer's recommendations. Cut end joints square and align for tight neat fit.
 - 4. Flanges of corner beads and control joints shall be coated with not less than two coats of taping compound sanded smooth.

3.05 GYPSUM BOARD ATTACHMENT

- A. Space fasteners not less than 3/8 inch not more than 1/2 inch from edges and ends of

gypsum board. While fasteners are being driven, hold the gypsum board in firm contact with underlying support. Proceed from the central portion of the gypsum board to the ends and edges. If the paper surfaces are broken by fastener in attachment, drive another fastener approximately 2 inches from the faulty fastener.

- B. Drive screws with a mechanical tool, using a special bit to provide screwhead penetration just below gypsum board surface, without breaking surface paper or stripping the framing member around the screw.
- C. Spacing of Fasteners - Screw Method:
 - 1. Walls: Space screws 16 inches o.c., maximum.
 - 2. Ceilings: Space screws 12 inches o.c., maximum.
 - 3. Fire rated construction: Space screws 12 inches o.c., maximum in field and 8 inches o.c. at edges, unless otherwise indicated closer in manufacturer's UL fire rated design.
 - 4. Fasten corner beads and trim with fasteners spaced 6 inches o.c., driven through gypsum board into framing members.

3.06 SHAFTWALL ASSEMBLY (Where Indicated)

- A. Install shaft wall studs, tracks, shaft liner, wallboard, accessories, and finish wallboard joints in accordance with ASTM C754 for metal framing and ASTM C840 for joint treatment and manufacturer's recommendations.

3.07 JOINT AND FASTENER TREATMENT

- A. Mix and use joint finishing materials in accord with manufacturer's published directions. Allow a minimum drying time of 24 hours between coats. Sand as necessary after each application without scuffing paper surface of gypsum board.
- B. Reinforce wall and ceiling angles and inside vertical corner angles with tape folded to conform to the adjoining surfaces and to form a straight, true angle.
- C. Embedment Coat: Apply a thin, uniform layer of joint compound (embedding type) approximately 3 inches wide over the joint to be reinforced. Center tape over the joint and seat into the compound, leaving sufficient compound under the tape to provide proper bond. Apply a skim coat of compound immediately after embedding tape.
- D. Fill Coat: After drying, apply fill coat over embedding coat by evenly spreading compound over and slightly beyond the tapered edge area of the gypsum board; feather at the edges.
- E. Topping: Cover fill coat with topping compound, spread evenly over and slightly beyond the edge of the proceeding coat; feather to a smooth, uniform finish.
- F. Fastener Concealment: Treat fastener dimples and holes as described for joint treatment.

- G. Conceal flanges of corners beads, casing beads, trim members and control joints by a minimum of two coats of compound applied in accord with manufacturer's published directions.
- H. Joints at Penetrations: Where pipes, conduits, ducts, electrical devices, and other items penetrate gypsum board, caulk as described in Section 07920.

END OF SECTION

**SECTION 095113
ACOUSTICAL PANEL CEILINGS**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 PREINSTALLATION MEETINGS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. LEED Submittals:
1. Product Data for Credit MR 4: For products having recycled content, documentation indicating percentages by weight of postconsumer and preconsumer recycled content. Include statement indicating costs for each product having recycled content.
 2. Laboratory Test Reports for Credit EQ 4: For ceiling systems, documentation indicating that products comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Evaluation reports.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP.

- B. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Build mockup of typical ceiling area as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
 - 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANEL CEILINGS, GENERAL

- A. Low-Emitting Materials: Acoustical panel ceilings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- B. Wet-formed mineral fiber.
- C. Acoustical Panel Standard: Comply with NRC 55.
- D. Metal Suspension System Standard: Comply with ASTM C 635.
- E. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

2.3 ACOUSTICAL PANELS <Insert drawing designation>

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings:
 - 1. Armstrong World Industries, Inc., fine fissured.

2.4 METAL SUSPENSION SYSTEM

- A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

Armstrong World Industries, Inc., 'Prelude' 15/16" exposed T. Recycled Content: Provide products made from steel sheet with average recycled content such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
 - 1. Arrange directionally patterned acoustical panels as indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 09900**PAINTING****PART 1. GENERAL****1.01 SECTION INCLUDES**

- A. Field painting of new or modified exterior and interior building surfaces not excluded by specifications.
- B. Field painting of existing exterior and interior building surfaces not excluded by specifications.

1.02 RELATED SECTIONS

- A. 013300 - Submittal Procedures
- B. 05520 - Handrails and Railings
- C. 08100 - Metal Doors and Frames
- D. 08210 - Wood Doors
- E. 09200 - Gypsum Drywall Systems
- F. 09210 - Gypsum Plaster
- H. Division 15 - Coating of piping, hangers and equipment in concealed spaces.
- I. Division 15 - Mechanical system item identification.
- J. Division 16 - Electrical system item identification.

1.03 SUBMITTALS

- A. Thirty days before starting this work, submit to Architect for color selection and review, manufacturer's color chips of full range of colors available for each type of paint specified. Colors selected by Architect may be colors selected to match another manufacturer's colors or colors selected to match a custom color sample.
- B. After product data review and color selection, submit samples of each type and color of paint selected, applied to sample of applicable surfaces.
- C. Selected color and sheen samples shall serve as quality standard for painting work throughout project for each color and paint type.

1.04 MAINTENANCE PAINT

- A. Provide (2) two one-gallon containers of each type and color of paint clearly identified as to type, color and location, for Owner's maintenance use.

PART 2. PRODUCTS

2.01 PAINT MANUFACTURERS AND PRODUCTS LIST

- A. Use only products manufactured by same manufacturer for primer or first coat and finish coats.
- B. Manufacturer's name abbreviations used in specifications:
 - 1. Devoe: Devoe & Raynolds Co.
 - 2. Glidden: Glidden Coating and Resins Co.
 - 3. MAB: M.A. Bruder & Sons, Inc.
 - 4. PPG: PPG Industries, Inc. (Pittsburgh Paints)
 - 5. SW: The Sherwin Williams Co.
 - 6. Benjamin Moore

2.02 FLAT EXTERIOR LATEX

- A. Devoe: Regency 12XX.
- B. Glidden: Spred Glide-On House Paint 3600X.
- C. MAB: Fresh Kote Latex Flat House Paint 409 Line.
- D. PPG: Exterior Latex Flat House Paint 72 Series.
- E. SW: Latex House and Trim Paint A6 Series.
- F. Benjamin Moore #171. Moorecraft Super Spec. Flat Latex Housepaint

2.03 ALKYD EXTERIOR METAL PRIMER

- A. Devoe: Mirrolac 1301.
- B. Glidden: Glid-Guard Alkyd Metal Primer 4570.
- C. MAB: Rust-O-Lastic Anti-Corrosive Primer 073-132.
- D. PPG: Speedhide Inhibitive Red Primer 6-208 or White 6-712.
- E. SW: Kromik Metal Primer E41N1.
- F. Benjamin Moore: #M06, Alkyd Metal Primer

2.04 ALKYD PRIMER FOR GALVANIZED METAL

- A. Devoe: Mirrocac 13201 Galvanized Primer.
- B. Glidden: Glid-Guard Galvanized Metal Primer 5229.
- C. MAB: Rust-O-Lastic Zinc Dust Primer 073-218.
- D. PPG: Speedhide Galvanized Metal Primer 6-209.
- E. SW: Galvite B50W3.
- F. Benjamin Moore: #C163, Ironclad Alkyd Low Luster Metal and Wood Enamel

2.05 ZINC-CHROMATE PRIMER FOR ALUMINUM

- A. Devoe: Bar-Ox Zinc Chromate primer No. 41839.
- B. Glidden: Glid-Guard Zinc Chromate Metal Primer No. 5533.
- C. MAB: Rust-O-Lastic Zinc Chromate Primer, Code 073-679.
- D. PPG: Speedhide Zinc Chromate Primer 6-204.
- E. SW: Zinc Chromate Primer B50Y1.

- F. Benjamin Moore: #CM18/CM19, I.M.C. Epoxy Zinc Rich Primer

2.06 VINYL WASH PRIMER

- A. Devoe: Galvanized Metal Primer 13201.
- B. Glidden: Glid-Guard Vinyl Chloride Metal Conditioning Primer 5240.
- C. MAB: Rust-O-Lastic Vinyl Wash Primer Code 760-093 Line.
- D. PPG: Polyclutch Wash Primer 97-687/688/731.
- E. SW: Wash Primer Green P60G2.

2.07 ALKYD EXTERIOR WOOD PRIMER

- A. Devoe: All Weather Alkyd Primer 1102.
- B. Glidden: Spred Gel Flow Prime Coat 3651.
- C. MAB: Seashore Exterior Primer Coat.
- D. PPG: Speedhide Exterior Wood Primer 1-870.
- E. SW: A100 Alkyd Exterior Wood Primer Y24W20.
- F. Benjamin Moore: #176, Moorecraft Super Spec. Alkyd Ext. Primer

2.08 GLOSS ALKYD EXTERIOR METAL ENAMEL

- A. Devoe: Mirrolac Enamel 70XX.
- B. Glidden: Glid-Guard Alkyd Industrial Enamel 4550.
- C. MAB: Rust-O-Lastic Finish 074 Line.
- D. PPG: Speedhide Exterior Interior Alkyd Gloss Enamel 6-252 Series.
- E. SW: Industrial Enamel B-54.
- F. Benjamin Moore: #M22, I.M.C. Urethane Alkyd Gloss Enamel

2.09 FLAT ALKYD EXTERIOR ENAMEL

- A. Devoe: Mirrolac Alkyd Flat.
- B. MAB: Fresh Kote House Paint 404 Line.
- C. SW: Promar Alkyd Flat House Paint.

2.10 PVA INTERIOR PRIMER SEALER

- A. Devoe: Wonder-Tones Vinyl Latex Primer Sealer 50801.
- B. Glidden: Ultra-Hide PVA Primer-Sealer 5019.
- C. MAB: Fresh Kote Vinyl Primer, Code 037-100.
- D. PPG: Speedhide Quick Drying Latex Primer-Sealer 6-2.
- E. SW: Promar 200 Latex Wall Primer B28W200.
- F. Benjamin Moore: #253, Moorecraft Super Spec. Latex Enamel Undercoater and Primer Sealer

2.11 FLAT INTERIOR LATEX

- A. Devoe: Wonder Tones 36XX.
- B. Glidden: Spread Satin 3425.
- C. MAB: Fresh Kote Latex Flat 402 Line.
- D. PPG: Speedhide Flat Interior Wall Paint 6-70.
- E. SW: Pro-Mar 200 Flat Wall Paint B30W200 Series.
- F. Benjamin Moore: #275, Moorecraft Super Spec. Latex Flat
- G. Zolatone

2.12 EGGSHELL/SATIN INTERIOR LATEX ENAMEL

- A. Devoe: Wonder-Tones Interior Latex Eggshell Enamel.
- B. Glidden: Ultra Hide Latex Satin Enamel.
- C. MAB: Rich Lux Wall-Shield.
- D. PPG: Speedhide Eggshell Latex Enamel.
- E. SW: ProMar 200 Latex Egg Shell Enamel.
- F. Benjamin Moore: #274, Moorecraft Super Spec. Latex Eggshell Enamel

2.13 SEMI-GLOSS INTERIOR LATEX ENAMEL

- A. Devoe: Wonder Tones Interior Acrylic Latex Semi-Gloss Enamel.
- B. Glidden: Spread Enamel - Latex Semi-Gloss.
- C. MAB: Fresh Kote Latex Semi-Gloss Enamel.
- D. PPG: Speedhide Latex Semi-Gloss Enamel.
- E. SW: ProMar 200 Latex Semi-Gloss Enamel.
- F. Benjamin Moore: #276, Moorecraft Super Spec. Latex Semi-Gloss Enamel

2.14 ALKYD INTERIOR METAL PRIMER

- A. Devoe: Mirrolac Rust Penetrating Metal Primer 13101.
- B. Glidden: Glid-Guard Metal Primer 4570 or Rust Master White 590.
- C. MAB: Rust-O-Lastic Anti-Corrosive Metal Primer 073-132.
- D. PPG: Speedhide Red Rust Inhibitive Primer 6-208 or White 6-712.
- E. SW: Kromik Metal Primer E41N1.
- F. Benjamin Moore: #C245, Super Alkyd Enamel Undercoater and Primes Sealer

2.15 ENAMEL UNDERCOATER

- A. Devoe: Velour Alkyd Enamel Undercoat 8801.
- B. Glidden: Spred Wood Undercoater 555.
- C. MAB: Fresh Kote Enamel Undercoater 037-181.
- D. PPG: Speedhide Quick Drying Enamel Undercoater 6-6.
- E. SW: ProMar Alkyd Enamel Undercoater B49W2.
- F. Benjamin Moore: #C245, Moorecraft Super Spec. Alkyd Enamel Undercoater and Primer Sealer

2.16 EGGSHELL ALKYD INTERIOR ENAMEL

- A. Devoe: Velour Alkyd Eggshell Enamel 23XX.
- B. Glidden: Ultra-Hide Eggshell Alkyd 5450.
- C. MAB: Rich Lux Low Lustre Enamel Alkyd 021 Line.
- D. PPG: Speedhide Alkyd Low Sheen Enamel 6-90.
- E. SW: Pro-Mar 200 Alkyd Egg-Shell Enamel B33 Series.
- F. Benjamin Moore: #C271, Super Spec. Alkyd Semi-Gloss Enamel

2.17 SEMI-GLOSS ALKYD INTERIOR ENAMEL

- A. Devoe: Velour Semi-Gloss Alkyd Enamel 26XX.
- B. Glidden: Spred Lustre Semi-Gloss 4600.
- C. MAB: Fresh Kote Alkyd Semi-Gloss 403 Line.
- D. PPG: Wallhide Semi-Gloss Alkyd Enamel 27 Line.
- E. SW: Pro-Mar Alkyd Semi-Gloss Enamel B34W200.
- F. Benjamin Moore: #C271, Super Spec. Alkyd Semi-Gloss Enamel

PART 3 EXECUTION

3.01 PREPARATION OF SURFACES

- A. Clean surface of all dirt, dust, or other contaminants, which adversely affects adhesion of paint or appearance of finish. Moisture content of masonry, concrete, plaster and drywall surfaces shall not exceed 15 percent measured using a moisture meter. Thoroughly wash surfaces containing excess alkalinity as recommended by paint manufacturer. Where existing painted surfaces delaminate from the drywall or plaster wall surface, Contractor shall peel off all of the existing finish down to the raw gypsum plaster for the entire length of the wall and retexture the entire wall with USG Multi Purpose Texture Finish (orange peel) or equal, then paint as specified for new surfaces.
- B. Stucco, Plaster, Concrete and Masonry:
 - 1. Remove fins, projections, protruding nails or other metal fastenings and loose or foreign materials.
 - 2. Remove form oil from concrete by washing with "Xylol".
 - 3. Patch large openings and holes with Portland cement mortar and after priming, fill remaining small depressions with a vinyl emulsion compound to match texture of surface as approved by the Paint Manufacturer.
 - 4. Overhead precast concrete slabs with damaged or missing areas of textured coating: Remove loose material back to soundly adhered material. Feather edges of sound textured coating down to concrete surface by power sanding or by power wire brushing. Clean bare concrete free of contaminates by power sanding or by power wire brushing so that new textured coating will bond properly.
- C. At Existing Painted Exterior Surfaces:

1. High pressure water blast or wire brush and water clean exterior before application of paint.
2. Contractor shall notify Owner before start of pressure cleaning operations with sufficient notice time to allow windows and doors to be closed and movable items in yards, to be removed for protection.
3. Protect existing electrical panel boxes, open conduit ends, HVAC or ventilation openings from high pressure, water spray damage by plastic sheeting taped and tied in place as required. After pressure cleaning operation, remove plastic sheeting covers and tape. Verify that windows and doors are closed and secure prior to start of cleaning operations.
4. Pressure cleaning operations or wire brush and water cleaning operation shall remove loose paint, scale, dirt, mold and other stains from building surfaces.

D. Gypsum Board:

1. New Work: Fill minor irregularities with spackling compound and sand to a smooth level surface exercising care to avoid raising nap of paper. Do not paint until compound has fully cured.
2. Existing Painted Surfaces: Remove grease, oil and other contaminants by washing with "Solax" dissolved in warm water, rinse thoroughly and dry. Remove loose and peeling paint and sand edges of sound paint flush.

E. At Existing Interior Surfaces:

1. Remove loose paint and peelings and use "ProSoco 859" paint stripper at all existing interior surfaces and fill minor irregularities with spackling compound prior to new paint application.

F. Woodwork:

1. New Work: Sand surfaces to achieve smooth finish. Prime wood to be painted and after drying, patch surface imperfections, cracks, holes, nail holes, and joints with putty, tinted to match transparent finish. Touch up knots and areas of high pitch content with shellac. Prepare surfaces to receive paint and transparent finishes before applying first coat. Do not sand faces of doors with medium density overlay finish.
2. Existing Painted Surfaces: Sand glossy surfaces to receive new enamel to remove gloss. Correct imperfections as specified above for new work. Wash surfaces with mineral spirits to remove grease and dirt.

- G. Metal: Wash metal surfaces with mineral spirits to remove grease, oil and dirt. Wire brush or sand surfaces to remove rust and scale. Touch up factory primed surfaces with compatible primer.

3.02 APPLICATION AND WORKMANSHIP

- A. Perform work using experienced, skilled painters in accordance with manufacturer's published directions. Mix and thin paint only as prescribed by the paint manufacturer.
- B. Apply paint using brush, rollers or airless spray equipment. Application methods used shall provide complete coverage, uniform colors, specified thickness, desired sheen and accepted texture. Cut in edges by brush next to trim, abutting items and internal corners. Repaint any surfaces where differences occur in coverage, or where surfaces contain runs, sags, holidays, brush marks, air bubbles or stipple.
- C. For each coat of paint use slightly different shade than preceding coat to distinguish various coats.
- D. Sand wood surfaces between each coat, dust and apply succeeding coats.
- E. Apply succeeding coats only after paint is thoroughly dry in accord with manufacturer's published directions.
- F. Finish paint tops, bottoms and side edges of hollow metal doors same as faces of doors.
- G. Back prime interior woodwork and cabinetwork before installation with material specified for prime coat.
- H. Before painting, remove or provide ample protection of hardware, accessories, plates, lighting fixtures and similar items. Replace items when painting is completed.
- I. At completion of work, touch up and restore field painted finish where damaged before occupancy.

3.03 SURFACES NOT TO BE PAINTED

- A. Painting is not required on pre-finished items, finished metal surfaces, concealed surfaces, operating parts, and labels.
- B. Pre-finished items not to be painted include the following factory finished items with a decorative finish of color acceptable to Architect:
 - 1. Acoustic materials.
 - 2. Architectural woodwork and casework.
 - 3. Finished mechanical and electrical equipment.
 - 4. Light fixtures.
 - 5. Switchgear.
 - 6. Distribution cabinets.
- C. Concealed surfaces not to be painted include wall or ceiling surfaces in the following generally inaccessible areas:
 - 1. Furred areas and spaces above suspended ceilings.

2. Pipe spaces.
 3. Interior of vertical shafts.
- D. Wall surfaces from a line ½ inch below top of resilient base to finish floor line. E.
- Finished metal surfaces not to be painted include:
1. Factory applied baked enamel surfaces.
 2. Anodized aluminum.
 3. Stainless steel.
 4. Chromium plate.
 5. Copper.
 6. Bronze.
 7. Brass.
- F. Operating parts not to be painted include moving parts of operating equipment including the following:
1. Valve stems, valve and damper operators.
 2. Linkages.
 3. Sensing devices.
 4. Motor and fan shafts.
- G. Labels: Do not paint over Underwriter's Laboratories, Factory Mutual or other code required labels or equipment name, identification, performance rating, or nomenclature plates.
- H. Underside of poured concrete slabs exposed and not identified in the Finish Schedule.

3.04 PAINTING SCHEDULE

- A. Provide paint finishes, locations and type of coatings in accord with the Finish Schedule, Paint Manufacturers and Products List and following schedule. Carefully examine requirements of specification sections for this project for location, extent and nature of painting work required, including items not specifically included in schedules.
- B. Existing Painted Surfaces: Omit following specified first coats provided that existing paint is unbroken, otherwise touch up or prime paint entire surface.
- C. Exterior Surfaces:
1. Stucco / Concrete:
3 Coats - Flat Exterior Latex.
 2. Stucco / Cement Plaster / Concrete / Masonry / Galvanized Metal: Anti-Graffiti Coating System.

- 1 Coat complete coverage - Ty-Cote Clear or Pigmented, Acrylic Base latex.
- 1 Coat complete coverage - Tex-Cote Clear Graffiti Guard III.
- 3. Ferrous Metal (Including piping, equipment and equipment supports on roofs):
Touch-Up Shop Primed Surface.
1 Coat - Alkyd Exterior metal Primer.
2 coats - Gloss Alkyd Exterior Enamel.
- 4. Galvanized Metal (Including flashings, ducts, piping, equipment and equipment supports on roofs):
1 Coat - Alkyd Primer for Galvanized Metal.
2 Coats - Gloss Alkyd Exterior Metal Enamel.
- 5. Aluminum:
1 Coat - Zinc Chromate Primer.
2 Coats - Gloss Alkyd Exterior Metal Enamel.
- 6. Wood Surfaces:
1 Coat Alkyd Primer.
2 Coats - Flat or Gloss Alkyd Exterior Enamel. As selected by Architect.

D. Interior Surfaces:

- 1. Gypsum Wallboard in toilet Rooms and other wet areas:
1 Coat - PVA Primer Sealer.
1 Coat - Alkyd Enamel Undercoater, or Devoe Mirrolac-WB Gloss Acrylic Enamel tinted to match finish coat.
2 Coats - Semi-Gloss Alkyd Enamel, or Devoe Mirrolac-WB Gloss Acrylic Enamel.
- 2. All Other Gypsum Wallboard, Cement Plaster and Gypsum Plaster Walls:
1 Coat - PVA Primer Sealer.
2 Coats - Eggshell or Semi-Gloss Interior Latex Enamel.
- 3. All Other Gypsum Wallboard, Cement Plaster and Gypsum Plaster Ceilings:
1 Coat - PVA Primer Sealer.
2 Coats - Flat Interior Latex.
- 4. Block and Concrete:
1 Coat - Block Filler (Concrete block only)
2 Coats - Eggshell or Semi-Gloss Latex
- 5. Ferrous Metal:
Touch-Up Shop Primed Surface. 1 Coat - Alkyd Metal Primer.
2 Coats - Eggshell Alkyd Enamel.
- 6. Galvanized Metal: Use same type primer as specified for exterior galvanized metal areas.
1 Coat - Alkyd Primer for Galvanized Metal.
2 Coats - Eggshell Alkyd Enamel.
- 7. Wood and Wood Trim (Paint Finish):
1 Coat - Alkyd Enamel Undercoater.
2 Coats - Eggshell Alkyd Enamel.

8. Exposed Ferrous Piping, Valves and Hangers:
1 Coat - Alkyd Interior Primer.
2 Coats - Eggshell Alkyd Enamel.
9. Exposed Pipe Insulation:
1 Coat - Quick Drying Emulsion Sealer.
2 Coats - Eggshell Alkyd Enamel.
10. Exposed Galvanized Ductwork, Piping and Conduits:
1 Coat - Alkyd Primer for Galvanized Metal.
2 Coats - Eggshell Alkyd Enamel.
11. Duct work visible through grilles or diffusers:
1 Coat - Alkyd Primer for Galvanized Metal.
1 Coat - Black Flat Alkyd Enamel.
12. Exposed Aluminum Ductwork and Conduit:
1 Coat - Zinc Chromate Primer.
2 Coats - Eggshell Alkyd Enamel.
13. Exposed Copper Tubing, Valves and Fittings:
1 Coat - Vinyl Wash Primer for Copper.
2 Coats - Eggshell Alkyd Enamel.

E. Identification of Mechanical and Electrical Items:

1. Provide color code painting of exposed piping and conduits in equipment rooms of colors for various items as specified in Mechanical and Electrical Sections.
2. Pipe contents and piping contents flow direction arrow labels and valve tags; electrical equipment and conductor labels are specified in Mechanical and Electrical Sections.

END OF SECTION

Public Works Administration Building Air Conditioning**PROJECT 12259****SECTION 09 91 13 - EXTERIOR PAINTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following exterior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Exterior portland cement plaster (stucco).
- B. Paint shall be selected from manufacturer's best quality commercial grade, professional coatings paint line, that also meet the environmental standards listed.
- C. Environmental Standards: Approved products must meet VOC standards of Zero VOC coatings where specified, a maximum amount of VOC's of 150 g/L for all Interior coatings (except WB Epoxy at 245 g/L) and 200 g/L for all Exterior coatings. Exterior Texture Coating for concrete is excluded.
- D. Related Requirements:
 - 1. Section 03 30 00 "Cast-In-Place Concrete" for material information.
 - 2. Section 03 47 13 "Tilt-Up Concrete" for material information.
 - 3. Section 04 20 00 "Unit Masonry" for material information
 - 4. Section 05 12 00 "Structural Steel Framing" for material information and primer coordination.
 - 5. Section 05 50 00 "Metal Fabrications" for material information and primer coordination.
 - 6. Section 07 92 00 "Joint Sealants" for material adjacent to paint material.
 - 7. Section 08 11 13 "Hollow Metal Doors and Frames" for material information and primer coordination.
 - 8. Section 09 24 00 "Portland Cement Plastering" for material information.
 - 9. Section 09 91 23 "Interior Painting" for surface preparation and the application of paint systems on interior substrates.
- E. References
 - 1. Florida Building Code (FBC), current edition.
 - 2. Painting and Decorating Contractors of America (PDCA).
 - 3. Florida Clean Air Act: Florida Department of Environmental Protection.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

EXTERIOR PAINTING**099113-1**

CAM 21-0549

Exhibit 1B

Page 47 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- D. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
 - 3. VOC content.
- D. Warranties: Project and manufacturers' warranties.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Attic Stock:
 - 1. Immediately prior to Final Completion, provide CITY OF FORT LAUDERDALE with a voucher for each color used in each coating material applied on the Project to purchase paint at later date instead of getting cans of attic stock paint.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Contractor Qualifications: Applicators shall be licensed Sub-Contractors, skilled in successful applications of the specified products on comparable projects for a minimum of 5 years.
- C. Manufacturer(s) Qualifications: Utilize only manufacturers making the specified products as a regular and current production item.

EXTERIOR PAINTING**099113-2**

CAM 21-0549

Exhibit 1B

Page 48 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

1. The Paint Manufacturer's Representative shall inspect the job and provide an approval signature at each painting phase (substrate inspection, primer coat application, first finish coat application, final finish coat application, etc...). A signed document shall be provided at Project Closeout certifying that the Manufacturer accepts the work with assurance that the Contractor has taken all the necessary steps to provide a satisfactory finished product.
- D. Pre-construction/Conferences:
1. Immediately prior to the start of Work for this Section, the Architect, in concert with CITY OF FORT LAUDERDALE, shall schedule a meeting with the General Contractor, Painting Sub-Contractor and Paint Manufacturer for the purpose of reviewing all elements necessary for the preparation, application and completion of Work. All deficiencies in substrates shall be noted and corrective action taken prior to commencement of Work.
 2. Project scheduling, phasing, area access and procedures to be employed shall also be discussed.
- E. Sample Finishes: The Architect, in concert with CITY OF FORT LAUDERDALE, shall designate sample room(s)/space(s) to receive representative complete finishes of each finish required. When acceptable to the Architect and CITY OF FORT LAUDERDALE in all respects (substrate preparation, surface moisture content, primer/filler application, finish coat application, mil thicknesses, etc.), these spaces shall be used as the basis for acceptability for all other similar finishes and spaces.
- F. Contractor's (Applicator) Acceptance:
1. It is assumed that the professional Painting Sub-Contractor (Applicator) is best qualified to recognize problems with substrates that could lead to coating failure.
 2. The Applicator shall certify acceptance of all substrates prior to the application of any material. The certification shall state that the substrate is acceptable and ready for the finish coating application to begin and that the substrates do not exceed the allowable recommended moisture content.
 3. Applicators shall not proceed with the Work until the Work is acceptable and certified as such by the Applicator.
- 1.7 WARRANTY
- A. Project Warranty: General Project Warranty shall be as stated in Division 1 of the Specifications.
 - B. Paint Manufacturer's Warranty: In addition to other warranties, the paint Manufacturer shall provide product warranties standard with the manufacturer of each product specified. Manufacturer shall warrant all exterior paint finishes for labor and materials against cracking and fading for a minimum of ten (10) years.
 - C. Texture Coating Manufacturer's Warranty: In addition to other warranties, the texture coating Manufacturer shall warrant the texture coating for labor and materials against cracking and fading for a minimum of ten (10) years.
 - D. Unless otherwise stated, duration of all warranties shall begin on the date of Substantial Completion.
- 1.8 COMMISSIONING
- A. Closeout Submittals: Submit final copies of manufacturer's warranties for each product specified.
 - B. Corrections: The Architect, in concert with CITY OF FORT LAUDERDALE, shall be the sole judge of defective work and the level of acceptability. Depending upon the gloss and texture of a

EXTERIOR PAINTING

Public Works Administration Building Air Conditioning**PROJECT 12259**

particular surface, it may be necessary for the entire surface (wall exposure, ceiling, rail, trim board, etc.) to be recoated to meet acceptable standards.

- C. Contractor's Statement of Compliance: The Painting Sub-Contractor (Applicator) shall provide certification that the specified materials have been installed in the required number of coats, and that they were applied to the minimum coating thicknesses in accordance with the Contract Documents and the manufacturer's instructions.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.10 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures, less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Exterior Paint Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Duron, Inc.
 - 2. Florida Paints
 - 3. Glidden Professional.
 - 4. M.A.B. Paints.
 - 5. PPG Industries, Inc.
 - 6. Porter Paint Company.
 - 7. Sherwin-Williams Company (The).
- B. Exterior Texture Coat Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Glidden Professional.
 - 2. Pittsburg Paints / PPG, Inc.
 - 3. Sherwin-Williams Company (The).
 - 4. Textured Coatings of America, Inc. (Tex-Cote).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Provide materials that comply with VOC limits of authorities having jurisdiction.

EXTERIOR PAINTING

099113-4

CAM 21-0549

Exhibit 1B

Page 50 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- D. Colors: Match Architect's samples as indicated in color schedules on drawings, Sherwin Williams is the basis of color design.

2.3 CITY OF FORT LAUDERDALE STANDARD EXTERIOR PAINT SCHEDULE

Aluminum	Industrial Grade Acrylic Semi-Gloss
CMU and Brick	Acrylic Latex Semi-Gloss
Concrete	Textured Coating
Ferrous Metals	Industrial Grade Acrylic Semi-Gloss
Galvanized Metals	Industrial Grade Acrylic Semi-Gloss
Stucco	Elastomeric
Wood	Acrylic Latex Semi-Gloss

2.4 EXTERIOR PAINTING SYSTEMS

- A. Products: Subject to compliance with the selected systems listed below, other products from manufacturers listed in 2.1.A may be incorporated into the Work:

Substrate	Cts.	Glidden Professional	Sherwin-Williams Co.	Pittsburgh Paints PPG
Aluminum (Industrial Grade S-G) [Min. Total 6.3 mils DFT] [System E- 1]	1st	DEVFLEX Acrylic Metal Primer 4020PF (apply to achieve min. 2.2 mils DFT)	Pro Industrial Pro-Cryl Universal Primer, B66- 310 Series (apply to achieve min. 2.2 mils DFT)	Pitt-Tech Plus 90-712 DTM Primer (apply to achieve min. 2.0 mils DFT)
	2nd	DEVFLEX High Perfor- mance Waterborne Acrylic Enamel, 4216L (apply to achieve min. 2.1 mils DFT)	Pro Industrial High Per- formance Acrylic, Semi- Gloss B66-650 Series (apply to achieve min. 2.5 mils DFT)	Pitt-Tech Plus 90-1210 SemiGloss DTM. (apply to achieve min. 2.2 mils DFT)
	3rd	DEVFLEX High Performance Waterborne Acrylic Enamel, 4216L (apply to achieve min. 2.1 mils DFT)	Pro Industrial High Performance Acrylic, Semi- Gloss B66-650 Series (apply to achieve min. 2.5 mils DFT)	Pitt-Tech Plus 90-1210 SemiGloss DTM. (apply to achieve min. 2.2 mils DFT)
CMU & Brick (Acrylic Latex S- G) [Min. Total 12.0 mils DFT] [System E- 2]	1st	BLOXFIL 4000 Interi- or/Exterior Heavy Duty Acrylic Block Filler (apply to achieve min. 10.0 mils DFT)	Heavy Duty Block Filler B42W46 (apply to achieve min. 8.0 mils DFT)	SpeedHide6-15 Block Filler (apply to achieve min.8.0 mils DFT)
	2nd	Professional 6403V For- tis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.8 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 2.2 mils DFT)
	3rd	Professional 6403V For- tis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.8 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 2.2 mils DFT)
	2nd	Professional 6403V For- tis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.8 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 2.2 mils DFT)
	3rd	Professional 6403V For- tis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.8 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 2.2 mils DFT)

EXTERIOR PAINTING**099113-5**

CAM 21-0549

Exhibit 1B

Page 51 of 150

Public Works Administration Building Air Conditioning

PROJECT 12259

Ferrous & Galvanized Metal Industrial Grade Acrylic (S-G) [Min. Total 6.4 mils DFT] [System E-4]	1st	Touch-up Shop-Coat Primer or DEVFLEX Acrylic Metal Primer 4020PF (apply to achieve min. 2.2 mils DFT)	Touch-up Shop-Coat Primer w/Pro-Cryl Universal Metal Primer B66-310 (apply to achieve min. 2.2 mils DFT)	Touch-up Shop-Coat Primer or Pitt-Tech Plus 90-712 DTM Primer (apply to achieve min. 2.2 mils DFT)
	2nd	DEV FLEX High-Performance Waterborne Acrylic Semi-Gloss Enamel 4216L (apply to achieve min. 2.1 mils DFT)	Pro Industrial High Performance Acrylic, Semi-Gloss B66-650 Series (apply to achieve min. 2.1 mils DFT)	Pitt-Tech Plus 90-1210 SemiGloss DTM. (apply to achieve min. 2.1 mils DFT)
	3rd	DEV FLEX High-Performance Waterborne Acrylic Semi-Gloss Enamel 4216L (apply to achieve min. 2.1 mils DFT)	Pro Industrial High Performance Acrylic, Semi-Gloss B66-650 Series (apply to achieve min. 2.1 mils DFT)	Pitt-Tech Plus 90-1210 SemiGloss DTM. (apply to achieve min. 2.1 mils DFT)
Stucco (Elastomeric Water - proofing System) [Min. Total 13.5 mils DFT]	1st	Concrete Coatings Bond-Prep Pigmented Bonding Primer Conditioner 3030-1200 (apply to achieve min. 3.6 mils DFT)	Loxon Concrete & Masonry Primer, A24W300 (apply to achieve min. 3.6 mils DFT)	Perma-Crete 4-2 Mason- ry Primer. (apply to achieve min. 3.6 mils)
	2nd	DECRA-FLEX 300 Exteri or Elastomeric Coatings – 2260 Smooth (apply to achieve min, 10.0 mils DFT)	SherLastic Elastomeric A5 Series (apply to achieve min, 10.0 mils DFT)	Perma-Crete 4-110 Pitt Flex Elastomeric. (apply to achieve min. 10.0 mils DFT)
	3rd	Not Required	Not Required	Not Required
Wood (Acrylic Latex S- G)	1st	HYDROSEALER Exterior Primer Sealer 6001 (ap ply to achieve min. 4.0 mils DFT)	Exterior Latex Wood Primer B42 W8041 (apply to achieve min. 2.0 mils DFT)	17-921 Seal Grip Acrylic Universal Prime (apply to achieve min. 2.0 mils DFT)
	2nd	Professional 6403V For- tis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.8 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 2.2 mils DFT)
	3rd	Professional 6403V For- tis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.8 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 2.2 mils DFT)

2.5 TEXTURE COAT SYSTEMS

- A. Products: Subject to compliance with the selected systems listed below, other products from manufacturers listed in 2.1.B may be incorporated into the Work:

Substrate		Glidden Professional	Sherwin-Williams	Textured Coatings of America	Pittsburgh Paints PPG
Concrete (Tilt-Up), Acrylic [Min. Total 18.0 mils DFT, [System ETCS-11]	1st	HYDROSEALER 6001 Primer Sealer (apply to achieve min. 1.7 mils DFT)	Loxon Concrete Masonry Primer, B24 W8300 (apply to achieve min. 3.2 mils DFT)	Tex-Cote XL 70 "W" Water t Primer (apply to achieve min. 1.5 mils DFT)	PPG PERMACRETE 4-809 Acrylic Ma-sonry Sealer. (apply to achieve min. 1.5 mils DFT)
	2nd	Texture Coatings Exterior 3230-4340 Me- dium (apply to achieve min. 16.0 mils DFT)	UltraCrete Textured Acrylic Masonry 'Top-coat, A44 W800 Series (apply to achieve min. 13.0 mils)	Tex-Cote XL 70 "W" Water based Tex- tured Coating (apply to achieve min. 9.0 mils DFT)	PERMA-CRETE® 4-50 Texture Coatings (apply to achieve min. 15.2 mils DFT)

EXTERIOR PAINTING

099113-6

CAM 21-0549

Exhibit 1B

Page 52 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

	3rd	Professional 6403V Fortis 450 Premium Exterior 100% Acrylic Satin (apply to achieve min. 1.2 mils DFT)	Duration K33 Exterior Acrylic Latex Satin (apply to achieve min. 2.6 mils DFT)	Tex-Cote COOLWALL SUPERCOTE Finish (apply to achieve min. 9.0 mils DFT)	Manor Hall 73-410 Acrylic Latex Satin (apply to achieve min. 1.5 mils DFT)
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2.6 TRAFFIC MARKING PAINT ON ASPHALT

Glidden Professional	Sherwin-Williams	Pittsburgh Paints PPG
Waterbased Acrylic TMP White 4800 Yellow 4800 Blue 4800	Setfast Acrylic Latex White TM2160 Yellow TM2159 Blue TM2133	Speedhide White 11-23 Yellow 11-34 Blue 11-25

2.7 SOURCE QUALITY CONTROL**A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:**

- Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
- Testing agency will perform tests for compliance with product requirements.
- Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION**3.1 EXAMINATION**

- Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
- Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - Concrete: 12 percent.
 - Masonry (Clay and CMU): 12 percent.
 - Portland Cement Plaster: 12 percent.
- Portland Cement Plaster Substrates: Verify that plaster is fully cured.
- Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- Proceed with coating application only after unsatisfactory conditions have been corrected.
 - Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

EXTERIOR PAINTING**099113-7**

CAM 21-0549

Exhibit 1B

Page 53 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceeds that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 CITY OF FORT LAUDERDALE SPECIAL PREPARATION REQUIREMENTS

- A. Prior to starting Work, the Applicator shall certify acceptance of all substrates.
- B. Carefully follow the paint manufacturer's recommendations for minimum surface acceptability and the recommendations of recognized trade associations.
- C. In general, substrates shall be dry, clean and slightly rough. Surfaces to be painted shall be free of dirt, oil, release agents, grease, rust, mill scale, efflorescence, laitance and other surface imperfections and contaminants or any substance which may adversely affect the performance of the coating before the application process begins.
- D. The paint manufacturer shall assist the Paint Contractor with prearranged site visits during surface preparation or product application phases of the job to assure the quality of the work meets all plans, specifications, or applicable standards. Site Visit Reports are required for all visits to the job by Manufacturer's representatives. Any deviations to the specifications must be included in the Site Visit Report and sent to the General Contractor and/or CM, Architect and CITY OF FORT LAUDERDALE. With the proper completion of the Site Visit Reports, the likelihood is increased that the manufacturers' products will be applied in a proper manner, consistent with and in accordance with label and/or data sheet directions and the written specification which may have been established for the job by other than the paint manufacturer. These Site Visit Reports will be furnished free of charge as a courtesy of the paint manufacturer.
- E. Inspections for pH will be required by paint manufacturer on all masonry and concrete surfaces and will be documented on approved inspection forms on the behalf of CITY OF FORT LAUDERDALE. Acceptable range shall be 8.0 pH to 9.0 pH. Surfaces will be inspected for proper Ph levels prior to the application of any primers, sealers or paint coatings. Inspections for DFT and wet film thickness will also be required by paint manufacturer and will be documented

EXTERIOR PAINTING**099113-8**

CAM 21-0549

Exhibit 1B

Page 54 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

on approved inspections forms on the behalf of CITY OF FORT LAUDERDALE. Copies will be given to CITY OF FORT LAUDERDALE and/or Project Manager.

- F. Exterior caulks and/or sealants shall not be applied until primers and/or sealers have been properly applied.
- G. Painting Contractor shall be responsible to see that all surface rust and mill scale is removed in accordance with the Steel Structures Painting Council. This process should be performed to a minimum of SSPC-SP-2, Hand Tool Cleaning or SSPC-SP-3, Power Tool Cleaning.
- H. Sand new metal surfaces to roughen surfaces prior to the application of primer. Glossy and semi-glossy surfaces shall receive similar attention prior to application of finish coat when repainting.
- I. Concrete, masonry, stucco, EIFS, plaster and similar surfaces shall be permitted to cure properly for 28 days, minimum, prior to application, unless specifically stated on the product data sheet, no exceptions allowed. Surfaces shall be checked with an electronic moisture meter for maximum allowable moisture content prior to application.
- J. Concrete, masonry, stucco, EIFS, plaster and similar surfaces shall be pressure cleaned with minimum 2500 psi, 8"-wide pattern water stream prior to the application of elastomeric systems. Surface shall then be water-bead tested to assure that contaminants have been removed. Note: Surfaces should be allowed to dry a minimum of 48 hours prior to priming or painting.
- K. Apply elastomeric patching compound to cracked stucco and concrete surfaces prior to applying elastomeric coating. Application of sealants or exterior caulking to cracked stucco and concrete surfaces is unacceptable.

3.4 COMPATIBILITY

- A. Materials shall be applied as one unified system, i.e. surface preparation, primer, second coat and third coat, all compatible products, each dependent upon the other, and as recommended by the coating manufacturer for a particular finish on a particular surface. Likewise, coating materials and equipment shall be compatible in use; finish coats shall be compatible with prime coats; prime coats shall be compatible with the surface to be coated; tools and equipment and the method of application shall be compatible with the coating to be applied.
- B. Thinners, if any, shall be only those recommended for that purpose by the manufacturer of the material to be thinned.
- C. Coating materials selected for systems for each type of surface shall be the product of a single manufacturer.

3.5 APPLICATION

- A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
 - 3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

EXTERIOR PAINTING**099113-9**

CAM 21-0549

Exhibit 1B

Page 55 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
 - D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed to view:
 - a. Equipment, including panelboards and switch gear.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - E. Ensure that exterior caulks and/or sealants have not been applied until primers and/or sealers have been properly applied.
 - F. Concrete, cement plaster (stucco), EIFS and CMU shall be allowed to cure for a minimum of 28 days prior to the application of any primers, finishes or coatings (including elastomerics). Concrete includes cast-in-place, pre-cast, tilt-wall, composite insulating panels and the like. Ensure that inspections for "Wet Film Thickness" (WFT) and "Dry Film Thickness" (DFT) are completed and approved.
 - G. Topcoats shall not be applied over inadequately cured primers.
 - H. Apply each coat in the dry film thickness as recommended by the coating manufacturer. Coating thickness is based on the recommended WFT and DFT as listed on product data sheet. Ensure that inspections for pH are completed and approved on all masonry and concrete surfaces prior to application of any primers, sealers or painting coatings.
 - I. Slightly vary the color of succeeding coats.
 - J. Allow sufficient time between successive coats for proper drying, in accordance to the manufacturer's written instructions.
 - K. The number of coats and film thickness required are the same regardless of application method. Coatings shall be solid, continuous and producing pinhole-free surfaces.
 - L. Omit primer over metal surfaces that have been shop primed and touchup painted.
 - M. If undercoats or other conditions show through final coat of paint, at no additional cost to CITY OF FORT LAUDERDALE, apply additional coats until paint film is of uniform finish, color and appearance. Give special attention to ensure that edges, corners, crevices welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
- 3.6 FIELD QUALITY CONTROL
- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.
- 3.7 CLEANING AND PROTECTION
- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

EXTERIOR PAINTING**099113-10**

CAM 21-0549

Exhibit 1B

Page 56 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.
- E. Provide "Wet Paint" signs to protect newly painted finishes.

END OF SECTION 09 91 13

Public Works Administration Building Air Conditioning**PROJECT 12259****SECTION 09 91 23 - INTERIOR PAINTING****PART 1 - GENERAL****1.1 RELATED DOCUMENTS**

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

1.2 SUMMARY

- A. Section includes surface preparation and the application of paint systems on the following interior substrates:
 - 1. Concrete.
 - 2. Concrete masonry units (CMU).
 - 3. Steel.
 - 4. Galvanized metal.
 - 5. Gypsum board.
 - 6. Wood.
- B. Paint shall be selected from manufacturer's best quality commercial grade, professional coatings paint line, that also meet the environmental standards listed.
- C. Environmental Standards: Approved products must meet VOC standards of Zero VOC coatings where specified, a maximum amount of VOC's of 150 g/L for all Interior coatings (except WB Epoxy at 245 g/L).
- D. Related Requirements:
 - 1. Section 03 30 00 "Cast-In-Place Concrete" for material information.
 - 2. Section 03 47 13 "Tilt-Up Concrete" for material information.
 - 3. Section 04 20 00 "Unit Masonry" for material information
 - 4. Section 05 12 00 "Structural Steel Framing" for material information and primer coordination.
 - 5. Section 05 50 00 "Metal Fabrications" for material information and primer coordination.
 - 6. Section 07 92 00 "Joint Sealants" for material adjacent to paint material.
 - 7. Section 08 11 13 "Hollow Metal Doors and Frames" for material information and primer coordination.
 - 8. Section 09 91 13 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
- E. References
 - 1. Florida Building Code (FBC), current edition.
 - 2. Painting and Decorating Contractors of America (PDCA).
 - 3. Florida Clean Air Act: Florida Department of Environmental Protection.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

INTERIOR PAINTING

Public Works Administration Building Air Conditioning**PROJECT 12259**

- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
- G. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- C. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.
- D. Warranties: Project and manufacturers' warranties.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Attic Stock:
 - 1. Immediately prior to Final Completion, provide CITY OF FORT LAUDERDALE with a voucher for each color used in each coating material applied on the Project to purchase paint at later date instead of getting cans of attic stock paint.

1.6 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
 - 1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least 100 sq. ft. (9 sq. m).
 - b. Other Items: Architect will designate items or areas required.
 - 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 - 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
- B. Contractor Qualifications: Applicators shall be licensed Sub-Contractors, skilled in successful applications of the specified products on comparable projects for a minimum of 5 years.

INTERIOR PAINTING**099123-2**

CAM 21-0549

Exhibit 1B

Page 59 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- C. Manufacturer(s) Qualifications: Utilize only manufacturers making the specified products as a regular and current production item.
 - 1. The Paint Manufacturer's Representative shall inspect the job and provide an approval signature at each painting phase (substrate inspection, primer coat application, first finish coat application, final finish coat application, etc...). A signed document shall be provided at Project Closeout certifying that the Manufacturer accepts the work with assurance that the Contractor has taken all the necessary steps to provide a satisfactory finished product.
- D. Pre-construction/Conferences:
 - 1. Immediately prior to the start of Work for this Section, the Architect, in concert with CITY OF FORT LAUDERDALE, shall schedule a meeting with the General Contractor, Painting Sub-Contractor and Paint Manufacturer for the purpose of reviewing all elements necessary for the preparation, application and completion of Work. All deficiencies in substrates shall be noted and corrective action taken prior to commencement of Work.
 - 2. Project scheduling, phasing, area access and procedures to be employed shall also be discussed.
- E. Sample Finishes: The Architect, in concert with CITY OF FORT LAUDERDALE, shall designate sample room(s)/space(s) to receive representative complete finishes of each finish required. When acceptable to the Architect and CITY OF FORT LAUDERDALE in all respects (substrate preparation, surface moisture content, primer/filler application, finish coat application, mil thicknesses, etc.), these spaces shall be used as the basis for acceptability for all other similar finishes and spaces.
- F. Contractor's (Applicator) Acceptance:
 - 1. It is assumed that the professional Painting Sub-Contractor (Applicator) is best qualified to recognize problems with substrates that could lead to coating failure.
 - 2. The Applicator shall certify acceptance of all substrates prior to the application of any material. The certification shall state that the substrate is acceptable and ready for the finish coating application to begin and that the substrates do not exceed the allowable recommended moisture content.
 - 3. Applicators shall not proceed with the Work until the Work is acceptable and certified as such by the Applicator.

1.7 WARRANTY

- A. Project Warranty: General Project Warranty shall be as stated in Division 1 of the Specifications.
- B. Paint Manufacturer's Warranty: In addition to other warranties, the paint Manufacturer shall provide product warranties standard with the manufacturer of each product specified. Manufacturer shall warrant all exterior paint finishes for labor and materials against cracking and fading for a minimum of ten (10) years.
- C. Unless otherwise stated, duration of all warranties shall begin on the date of Substantial Completion.

1.8 COMMISSIONING

- A. Closeout Submittals: Submit final copies of manufacturer's warranties for each product specified.
- B. Corrections: The Architect, in concert with CITY OF FORT LAUDERDALE, shall be the sole judge of defective work and the level of acceptability. Depending upon the gloss and texture of a particular surface, it may be necessary for the entire surface (wall exposure, ceiling, rail, trim board, etc.) to be recoated to meet acceptable standards.

INTERIOR PAINTING**099123-3**

CAM 21-0549

Exhibit 1B

Page 60 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- C. Contractor's Statement of Compliance: The Painting Sub-Contractor (Applicator) shall provide certification that the specified materials have been installed in the required number of coats, and that they were applied to the minimum coating thicknesses in accordance with the Contract Documents and the manufacturer's instructions.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).
 - 1. Maintain containers in clean condition, free of foreign materials and residue.
 - 2. Remove rags and waste from storage areas daily.

1.10 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures, less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS**2.1 MANUFACTURERS**

- A. Interior Paint Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Color Wheel Paints
 - 2. Duron, Inc.
 - 3. Florida Paints
 - 4. Glidden Paints
 - 5. M.A.B. Paints.
 - 6. PPG Architectural Finishes, Inc.
 - 7. Porter Paint Company.
 - 8. Sherwin-Williams Company (The).

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24)].
 - 1. Flat Paints and Coatings: 50 g/L.
 - 2. Nonflat Paints and Coatings: 150 g/L.
 - 3. Dry-Fog Coatings: 400 g/L.
 - 4. Primers, Sealers, and Undercoaters: 200 g/L.
 - 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

INTERIOR PAINTING**099123-4**

CAM 21-0549

Exhibit 1B

Page 61 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.

- D. Colors: Match Architect's samples as indicated in color schedules on drawings, Sherwin Williams is the basis of color design.

2.3 CITY OF FORT LAUDERDALE STANDARD INTERIOR PAINT SCHEDULE

CMU & Exposed Concrete Walls	Semi-Gloss Latex or WB Epoxy S-G
GWB Walls and Ceilings	Semi-Gloss Latex or WB Epoxy S-G
Ferrous Metal (doors & frames, etc.)	Acrylic Semi-Gloss
Galvanized Metal (pipe rails, gratings)	Acrylic Semi-Gloss
Painted Wood (trim, shelving, etc.)	WB Epoxy Gloss

2.4 INTERIOR PAINTING SYSTEMS

- A. Products: Subject to compliance with the selected systems listed below, other products from manufacturers listed in 2.1.A may be incorporated into the Work:

Substrate	Cts.	Glidden Professional	Sherwin-Williams Co.	Pittsburgh Paints PPG
CMU Dry Areas (Where scrubbing is required) (Epoxy S-G) [Min. Total 12.0 mils DFT] [System I-1]	1st	Concrete Coatings Block Filler 3010-1200 (apply to achieve min. 8.0 mils DFT)	PrepRite Block Filler B25W25 (apply to achieve min. 8.0 mils DFT)	SpeedHide 6-15 Block Filler (apply to achieve min. 10.0 mils DFT)
	2nd	TRU-GLAZE-WB 4426 Waterborne Epoxy Semi-Gloss (apply to achieve min. 2.0 mils DFT)	Pro Industrial Pre-Catalyzed Water based Epoxy, Semi-Gloss K46-150 Series (apply to achieve min. 2.0 mils DFT)	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 1.5 mils DFT)
	3rd	TRU-GLAZE-WB 4426 Waterborne Epoxy Semi-Gloss (apply to achieve min. 2.0 mils DFT)	Pro Industrial Pre-Catalyzed Water-based Epoxy, Semi-Gloss K46-150 Series (apply to achieve min. 2.0 mils DFT)	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 1.5 mils DFT)
CMU Wet Areas (Toilets, Locker Rooms & Kitchens) (Epoxy Gloss) [Min. Total 12.0 mils DFT] [System I-2]	1st	TRU-GLAZE-WB 4015 Waterproofing Block Filler (apply to achieve min. 8.0 mils DFT)	Heavy Duty Block Filler B42W46 (apply to achieve min. 8.0 mils DFT)	SpeedHide 6-15 Block Filler (apply to achieve min. 10.0 mils DFT)
	2nd	TRU-GLAZE-WB 4428 Waterborne Epoxy Gloss (apply to achieve min. 2.0 mils DFT)	Water Based Catalyzed Epoxy Gloss B70/B60V15 (apply to achieve min. 2.5 mils DFT)	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 1.5 mils DFT)
	3rd	TRU-GLAZE-WB 4428 Waterborne Epoxy Gloss (apply to achieve min. 2.0 mils DFT)	Water Based Catalyzed Epoxy Gloss B70/B60V15 (apply to achieve min. 2.5 mils DFT)	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 1.5 mils DFT)
Concrete Dry Areas (Zero VOC Primer & Latex S-G) [Min. Total 4.8 mils DFT] [System I-3]	1st	Concrete Coatings Block Filler 3010-1200 (apply to achieve min. 2.0 mils DFT)	Loxon Concrete & Masonry Primer, A24W300 (apply to achieve min. 3.6 mils DFT)	SpeedHide 6-15 Block Filler (apply to achieve min. 8.0 mils DFT)
	2nd	ULTRA-HIDE No VOC Semi-Gloss 1415 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC S/G B30-2600 Series (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4510XI Semi-Gloss (apply to achieve min. 1.5 mils DFT)
	3rd	ULTRA-HIDE No VOC Semi-Gloss 1415 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC S/G B30-2600 Series (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4510XI Semi-Gloss (apply to achieve min. 1.5 mils DFT)

INTERIOR PAINTING**099123-5**

CAM 21-0549

Exhibit 1B

Page 62 of 150

Public Works Administration Building Air Conditioning

PROJECT 12259

GWB Dry Areas (Epoxy S-G) [Min. Total 6.0 mils DFT] [System I-4]	1st	LIFEMASTER No VOC Interior Primer 9116-1200 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC Interior Primer B28W02600 (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4900 XI Primer (apply to achieve min. 2.0 mils DFT)
	2nd	TRU-GLAZE-WB 4426 Waterborne Epoxy Semi-Gloss apply to achieve min. 2.0 mils DFT)	Pro Industrial Pre-Catalyzed Water based Epoxy, Semi-Gloss K46-150 Series (apply to achieve min. 2.0 mils DFT)	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 2.0 mils DFT)
	3rd	TRU-GLAZE-WB 4426 Waterborne Epoxy Semi-Gloss apply to achieve min. 2.0 mils DFT)	Pro Industrial Pre-Catalyzed Water based Epoxy, Semi-Gloss K46-150 Series (apply to achieve min. 2.0 mils DFT)	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 2.0 mils DFT)
GWB (Latex S-G) [Min. Total 6.0 mils DFT] [System I-5]	1st	LIFEMASTER No VOC Interior Primer 9116-1200 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC Interior Primer B28W02600 (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4900 XI Primer (apply to achieve min. 2.0 mils DFT)
	2nd	ULTRA-HIDE No VOC Semi-Gloss 1415 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC S/G B30-2600 Series (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4510XI Semi-Gloss (apply to achieve min. 2.0 mils DFT)
	3rd	ULTRA-HIDE No VOC Semi-Gloss 1415 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC S/G B30 2600 Series (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4510XI Semi-Gloss (apply to achieve min. 2.0 mils DFT)
CMU (Latex S-G) [Min. Total 12.0 mils DFT] [System I-6]	1st	Concrete Coatings Block Filler 3010- 1200 (apply to achieve min. 8.0 mils DFT)	PrepRite Block Filler B25W25 (apply to achieve min. 8.0 mils DFT)	SpeedHide 6-15 Block Filler (apply to achieve min. 10.0 mils DFT)
	2nd	ULTRA-HIDE No VOC Semi-Gloss 1415 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC S/G B30-2600 Series (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4510XI Semi-Gloss (apply to achieve min. 1.5 mils DFT)
	3rd	ULTRA-HIDE No VOC Semi-Gloss 1415 (apply to achieve min. 2.0 mils DFT)	ProMar 200 Zero VOC S/G B30 2600 Series (apply to achieve min. 2.0 mils DFT)	SpeedHide Zero VOC 6-4510XI Semi-Gloss (apply to achieve min. 1.5 mils DFT)
Ferrous Metal & Galvanized Metal (WB Epoxy Gloss) [Min. Total 6.2 mils DFT] [System I-7]	1st	Touch-up Shop-Coat Primer or DEVFLEX Acrylic Metal Primer 4020PF (apply to achieve min. 2.2 mils DFT)	Touch-up Shop-Coat Primer or Pro-Cryl Universal Metal Primer B66-310 (apply to achieve min. 2.2 mils DFT)	Touch-up Shop-Coat Primer or Pitt-Tech Plus 90-712 DTM Primer (apply to achieve min. 2.2 mils DFT)
	2nd	TRU-GLAZE-WB 4428 Waterborne Epoxy Gloss apply to achieve min. 2.0 mils DFT]	Water Based Catalyzed Epoxy Gloss B70/B60V15 (apply to achieve min. 2.5 mils DFT]	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 2.0 mils DFT)
	3rd	TRU-GLAZE-WB 4428 Waterborne Epoxy Gloss [apply to achieve min. 2.0 mils DFT]	Water Based Catalyzed Epoxy Gloss B70/B60V15 (apply to achieve min. 2.5 mils DFT]	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 2.0 mils DFT)
Painted Wood (Epoxy S-G) [Min. Total	1st	GRIPPER 3210 Interi-or Exterior Primer Sealer (apply to achieve min. 2.0 mils DFT)	Premium Wall Wood Primer B28W8111 (apply to achieve min. 1.8 mils DFT)	17-921 Seal Grip Acrylic Universal Prime (apply to achieve min. 2.0 mils DFT)

INTERIOR PAINTING

099123-6

CAM 21-0549

Exhibit 1B

Page 63 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

6.3 mils DFT] [System I-8]	2nd	TRU-GLAZE-WB 4426 Waterborne Epoxy Semi-Gloss (apply to achieve min. 2.2 mils DFT]	Water Based Catalyzed Epoxy Semi-Gloss B70/B60V25 (apply to achieve min. 2.5mils DFT]	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 2.2 mils DFT)
	3rd	TRU-GLAZE-WB 4426 Waterborne Epoxy Semi-Gloss (apply to achieve min. 2.2 mils DFT]	Water Based Catalyzed Epoxy Semi-Gloss B70/B60V25 (apply to achieve min. 2.5mils DFT]	PITT-GLAZE 16-510 WB1 Water-Borne Acrylic Epoxy (apply to achieve min. 2.2 mils DFT)

2.5 INTERIOR RE-PAINTING SYSTEMS (Due to environmental concerns of painting metal doors and frames while buildings are occupied, this schedule is a substitute for alkyd-based paints.):

Substrate	Cts.	Glidden Professional	Sherwin-Williams Co.	Pittsburgh Paints PPG
Acrylic over Alkyd (Acrylic Gloss) [Min. Total 6.4 mils DFT] [System IE-1]	1st	Touch-up prime as required (apply to achieve min. 2.2 mils DFT)	Touch-up prime as required (apply to achieve min. 2.2 mils DFT)	Touch-up prime as required (apply to achieve min. 2.2 mils DFT)
	2nd	DEVFLEX Acrylic 4208QD (apply to achieve min. 2.1 mils DFT)	ProMar 200 Zero VOC S/G B30-2600 Series (apply to achieve min. 2.1 mils DFT)	Pitt-Tech Plus 90-1210 Semi-Gloss DTM. (apply to achieve min. 2.1 mils DFT)
	3rd	DEVFLEX Acrylic 4208QD, if required for cove. (apply to achieve min. 2.1 mils DFT)	ProMar 200 Zero VOC S/G B30-2600 Series (apply to achieve min. 2.1 mils DFT)	Pitt-Tech Plus 90-1210 Semi-Gloss DTM. (apply to achieve min. 2.1 mils DFT)

2.6 CONCRETE FLOORS STAIN:

- A. Use for Service Rooms, Mechanical Rooms, Electrical Rooms, Custodial spaces.
- B. Water-Based Acrylic, solid/opaque color stain (gray), 2-coat application. The concrete floor must be etched, cleaned, vacuumed, and prepared (stain, grease removal, etc.) per manufacturer's recommendations:
 1. Glidden Professional: "Concrete Coatings" Concrete Stain 3610.
 2. Sherwin-Williams: "H&C Shield Plus Ultra Concrete Stain Solid Color.
 3. ICI Paints: "Groundworks" Water-based Acrylic Concrete Stain

2.7 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
 1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

INTERIOR PAINTING**099123-7**

CAM 21-0549

Exhibit 1B

Page 64 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259****PART 3 - EXECUTION****3.1 EXAMINATION**

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

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 CITY OF FORT LAUDERDALE SPECIAL PREPARATION REQUIREMENTS

- A. Prior to starting Work, the Applicator shall certify acceptance of all substrates.

INTERIOR PAINTING**099123-8**

CAM 21-0549

Exhibit 1B

Page 65 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. Carefully follow the paint manufacturer's recommendations for minimum surface acceptability and the recommendations of recognized trade associations.
 - C. In general, substrates shall be dry, clean and slightly rough. Surfaces to be painted shall be free of dirt, oil, release agents, grease, rust, mill scale, efflorescence, laitance and other surface imperfections and contaminants or any substance which may adversely affect the performance of the coating before the application process begins.
 - D. The paint manufacturer shall assist the Paint Contractor with prearranged site visits during surface preparation or product application phases of the job to assure the quality of the work meets all plans, specifications, or applicable standards. Site Visit Reports are required for all visits to the job by Manufacturer's representatives. Any deviations to the specifications must be included in the Site Visit Report and sent to the General Contractor and/or CM, Architect and CITY OF FORT LAUDERDALE. With the proper completion of the Site Visit Reports, the likelihood is increased that the manufacturers' products will be applied in a proper manner, consistent with and in accordance with label and/or data sheet directions and the written specification which may have been established for the job by other than the paint manufacturer. These Site Visit Reports will be furnished free of charge as a courtesy of the paint manufacturer.
 - E. Inspections for pH will be required by paint manufacturer on all masonry and concrete surfaces and will be documented on approved inspection forms on the behalf of CITY OF FORT LAUDERDALE. Acceptable range shall be 8.0 pH to 9.0 pH. Surfaces will be inspected for proper Ph levels prior to the application of any primers, sealers or paint coatings. Inspections for DFT and wet film thickness will also be required by paint manufacturer and will be documented on approved inspections forms on the behalf of CITY OF FORT LAUDERDALE. Copies will be given to CITY OF FORT LAUDERDALE and/or Project Manager.
 - F. Exterior caulks and/or sealants shall not be applied until primers and/or sealers have been properly applied.
 - G. Painting Contractor shall be responsible to see that all surface rust and mill scale is removed in accordance with the Steel Structures Painting Council. This process should be performed to a minimum of SSPC-SP-2, Hand Tool Cleaning or SSPC-SP-3, Power Tool Cleaning.
 - H. Sand new metal surfaces to roughen surfaces prior to the application of primer. Glossy and semi-glossy surfaces shall receive similar attention prior to application of finish coat when repainting.
 - I. Concrete, masonry, stucco, EIFS, plaster and similar surfaces shall be permitted to cure properly for 28 days, minimum, prior to application, unless specifically stated on the product data sheet, no exceptions allowed. Surfaces shall be checked with an electronic moisture meter for maximum allowable moisture content prior to application.
 - J. Concrete, masonry, stucco, EIFS, plaster and similar surfaces shall be pressure cleaned with minimum 2500 psi, 8"-wide pattern water stream prior to the application of elastomeric systems. Surface shall then be water-bead tested to assure that contaminants have been removed. Note: Surfaces should be allowed to dry a minimum of 48 hours prior to priming or painting.
 - K. Apply elastomeric patching compound to cracked stucco and concrete surfaces prior to applying elastomeric coating. Application of sealants or exterior caulking to cracked stucco and concrete surfaces is unacceptable.
- 3.4 COMPATIBILITY
- A. Materials shall be applied as one unified system, i.e. surface preparation, primer, second coat and third coat, all compatible products, each dependent upon the other, and as recommended by the coating manufacturer for a particular finish on a particular surface. Likewise, coating materials and equipment shall be compatible in use; finish coats shall be compatible with prime coats; prime coats shall be compatible with the surface to be coated; tools and equipment and the method of application shall be compatible with the coating to be applied.

INTERIOR PAINTING**099123-9**

CAM 21-0549

Exhibit 1B

Page 66 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- B. Thinners, if any, shall be only those recommended for that purpose by the manufacturer of the material to be thinned.
- C. Coating materials selected for systems for each type of surface shall be the product of a single manufacturer.

3.5 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
 - 1. Use applicators and techniques suited for paint and substrate indicated.
 - 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 - 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 - 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 - 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- C. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- D. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Metal conduit, follow CITY OF FORT LAUDERDALE color coding requirements.
 - b. Tanks that do not have factory-applied final finishes.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards, if not factory finished.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Ducts and equipment if not factory equipment.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.
- E. Ensure that exterior caulks and/or sealants have not been applied until primers and/or sealers have been properly applied.
- F. Concrete, cement plaster (stucco), EIFS and CMU shall be allowed to cure for a minimum of 28 days prior to the application of any primers, finishes or coatings (including elastomerics). Concrete includes cast-in-place, pre-cast, tilt-wall, composite insulating panels and the like. Ensure that inspections for "Wet Film Thickness" (WFT) and "Dry Film Thickness" (DFT) are completed and approved.
- G. Topcoats shall not be applied over inadequately cured primers.

INTERIOR PAINTING**099123-10**

CAM 21-0549

Exhibit 1B

Page 67 of 150

Public Works Administration Building Air Conditioning**PROJECT 12259**

- H. Apply each coat in the dry film thickness as recommended by the coating manufacturer. Coating thickness is based on the recommended WFT and DFT as listed on product data sheet. Ensure that inspections for pH are completed and approved on all masonry and concrete surfaces prior to application of any primers, sealers or painting coatings.
- I. Slightly vary the color of succeeding coats.
- J. Allow sufficient time between successive coats for proper drying, in accordance to the manufacturer's written instructions.
- K. The number of coats and film thickness required are the same regardless of application method. Coatings shall be solid, continuous and producing pinhole-free surfaces.
- L. Omit primer over metal surfaces that have been shop primed and touchup painted.
- M. If undercoats or other conditions show through final coat of paint, at no additional cost to CITY OF FORT LAUDERDALE, apply additional coats until paint film is of uniform finish, color and appearance. Give special attention to ensure that edges, corners, crevices welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3.6 FIELD QUALITY CONTROL

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

3.7 CLEANING AND PROTECTION

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

END OF SECTION 09 91 23

**SECTION 23 00 01
CLEANING OF HVAC SYSTEMS**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE OF THE WORK

- A. Provide all labor, materials, facilities, equipment and services to thoroughly clean HVAC systems noted on the plans.
- B. The cleaning work for each building is to include but not limited to the following components:
1. Main Air Handling Unit(s) or Roof Top Unit(s):
 - a. Unit enclosure.
 - b. Heating and cooling coils.
 - c. Fan assembly.
 - d. Condensate pan.
 - e. Replacement of existing filters and/or filter section.
 - f. Outside air and return air plenum(s).
 - g. Outside air intake(s).
 2. All supply and return ductwork, lined and unlined, including ductwork plenums, branches, risers, etc.
 3. All associated air terminal devices, i.e. supply diffuses, return registers, etc.
 4. Variable air volume (VAV) boxes.
 5. Reheat coils (electric or hot water).
 6. Sound attenuators.
 7. Exhaust duct system and all associated registers.
 8. Exhaust fan and return fan.
 9. Fire and fire/smoke dampers.
 10. Dust collector systems including:
 - a. Dust collector.
 - b. Filter bag replacement.
 - c. Ductwork system.
- C. Contractor will provide all labor, material and services to obtain access to HVAC units and associated components including:
1. Removal of ceiling tiles.
 2. Installation of new access panels and removal/replacement of existing panels.

3. See Section 3.9 for specification on reinstallation of removed materials.
- D. The bidders are encouraged to attend the pre-bid, site visit conference prior to submission of a bid proposal, to compare site conditions with drawings and/or specifications and to satisfy themselves of conditions existing at the site and all other matters that may be incidental to the work performed under this contract. No allowance will be made to the successful contractor by reason of any error on his/her part due to neglect to comply with the requirements of this paragraph. No extra charge will be allowed for work caused by unfamiliarity with the work area.
- E. It is the responsibility of the Contractor to verify field conditions before start of work.
- F. The Contractor will repair and replace to match existing materials where access to walls or ceilings was made, or damage occurs, including but are not limited to:
 1. Ductwork and components.
 2. Insulation.
 3. Pneumatic and electric control components.
 4. Others as applicable.
- G. Scope of the work also includes the following:
 1. The Contractor, on the basis of field inspections and review, must determine the method of cleaning the HVAC systems and its component to prevent any damage to the system and its operation. Upon completion of the initial inspection, the Contractor will notify the Project Engineer of the proposed methods and their effects to the system.
 2. Reset all balancing dampers to original settings if moved during work. Be sure to mark original position so that during the final inspection, original settings can be field verified.
 3. Report to Project Engineer any system defects discovered during the cleaning operation, which will require repair to an HVAC system (e.g. equipment, ductwork, dampers, registers, etc.).

1.3 QUALITY ASSURANCE

- A. Ductwork shall be cleaned in compliance with latest edition of the following standards:
 1. Mechanical cleaning of non-porous air conveyance system components, NADCA Latest Edition.
 2. Debris levels shall conform to:

Surface Debris Weight < 100MG/100cm³

Total Surface Bacteria < 30,000 cfu/g

Total Surface Mold < 15,000 cfu/g

Note: cfu/g refers to colony forming units per gram of debris.
 3. Plans and specifications which exceed the requirements in any of the referenced standards.
- B. All sheet metal shall be fabricated and installed by an experienced Contractor specializing in this type of work and approved by the Engineer.

1.4 SUBMITTALS TO THE ARCHITECT/ENGINEER

- A. Shop drawings locating all proposed duct penetrations and ceiling access holes in plaster ceilings.

- B. Provide MSDS sheets on all solvents, cleaners and disinfectants to be used on the project.
- C. Provide submittals on any equipment or materials replacing the existing during the remediation process, i.e., diffusers, flex duct, fire dampers.

PART 2 - PRODUCTS

2.1 DUCT ACCESS DOORS

- A. Fabricate in accordance with SMACNA Duct Construction Standards.
- B. Review locations with the Project Engineer prior to installation.
- C. Fabricate rigid and close-fitting doors or galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, install minimum one inch (25 mm) thick insulation sheet metal cover. All materials to be approved prior to use.
- D. Access doors smaller than 12 inches may be secured with sash locks.
- E. Provide two hinges and two sash locks for sizes up to 18 inches (450 mm) square, three hinges and two compression latches with outside and inside handles for sizes up to 24 x 49 inches (600 x 1200 mm). Provide an additional hinge for large sized.
- F. Access doors with sheet metal screw fasteners are not acceptable.
- G. All doors must be leak tight at the completion of the job.
- H. Doors shall be similar to Ventlock insulated access door, or Ruskin Model #CAD.

2.2 DUCT DISINFECTANT

- A. Equal to Madacide, as supplied by Mateson Chemical, EnviroCon as manufactured by Bio-Cide International, Inc., or approved equal.

2.3 SANITIZER * This product is no longer approved by the EPA.

- A. An E.P.A. registered sanitizer "Oxine" as manufactured by Bio-Cide International or approved equal. Product shall be a mixture of Oxychloride compounds.

2.4 ENCAPSULANT

- A. Carlisle RE-500 is a high-performance, spray-applied insulation encapsulant and coating. This spray coating provides resistance to mold growth and is designed for use inside HVAC ductwork to encapsulate surfaces of lined ducts to prevent fiberglass fibers from becoming airborne. At 13 g/l this low-VOC coating is ideal for critical projects such as hospitals and schools. The semi-gloss finish provides a surface that will prevent debris accumulation that could lead to mold growth.

- 2.5 **PLENUM PLANT *Porta Sept is no longer approved by EPA. It has cancer causing agents in it.**

PART 3 - EXECUTION

3.1 PRE-CLEANING PREPARATIONS

- A. Prior to start of work, the HVAC system is to be carefully inspected and checked for all conditions affecting the cleaning. Defects are to be reported in writing to the Project Engineer, and work will not precede until defects have been documented. Commencement of work will constitute acceptance of the conditions of the area to which the cleaning work is to be performed, and all defects in work resulting from such accepted service will be corrected by this trade without additional expense to the Owner. No cleaning is to be performed to ducts where the process has the capability of damaging the duct lining. This decision will be made by the Project Engineer after review of the Contractor's findings, and the Project Engineer has seen the field conditions.
- B. Disassemble all removable items as required for access to work area. Store the removables in a Project Engineer approved storage area until the completion of the cleaning work.
- C. Fire protection devices (such as smoke detectors, panel, etc.) shall be protected prior to cleaning procedures. They are to be cleaned and tested at the conclusion of the work.
- D. The Contractor shall coordinate the shutdown and reactivating of the fire alarm system to avoid accidental alarms during cleaning process and related work.
- E. The Contractor shall coordinate the shutdown of the air handling equipment with the Owner before starting work, and shall conform to the OSHA requirements regarding fan motor disconnect lock-outs.
- F. The mechanical contractor shall hire a 3rd party hygienist to run this test. It cannot be performed by the air duct cleaning contractor.

3.2 CLEANING PROCEDURES

- A. Sequence of work on each air handling system:
 - 1. Review area with the Project Engineer.
 - 2. Determine locations of HVAC units, ductwork, ventilation needs, sensitive equipment protection requirements, access and cleaning procedures.
 - 3. Notify Maintenance Staff to shut down the air handling system(s).
 - 4. CLEANING AND REMOVAL METHOD
- B. The following general ductwork cleaning procedures are to be used as a guideline throughout the project. Determination of which method should be used in each area is to be made by the Contractor and the Project Engineer. Contractors are to provide detailed procedures in their bid proposal. Deviations from specified methods of removal must be approved by the Project Engineer prior to their implementation.
- C. Methods:
 - 1. Debris Collection Equipment:

- a. Equipment used shall be portable and sized to enter the areas easily. Electrical requirements shall be the responsibility of the Contractor, and any cost incurred due to modifications to the electrical systems shall be at the Contractor's expense.
 - b. The collection systems shall be self-contained units, with the appropriate components to adequately collect dirt and debris loosened from the ductwork. Air duct cleaning is to be performed by a high powered vacuum system with three stages of filtration. The final stage shall be HEPA filter. HEPA efficiency shall be 99.97 @ 0.3 micron.
 - c. The collection system shall be capable of producing a minimum of .42" water gauge negative static pressure in the area of ductwork to be cleaned.
2. Agitation Equipment:
- a. Air power cleaning of all interior ductwork, fan housings and HVAC units performed by a high pressure compressed air system which will be directed through small access doors in the ductwork. All access doors are to be provided per Section 2.1.
 - b. Compressed air powered Gollum technology generating 90 CFM at 110 psi, as means of dislodging the debris shall be used. Air powered lances, extended whip sections, or oscillating brush systems may also be used.
 - c. Electric robotic air powered brushing systems, or electric rotary brush systems may be used.
 - d. Cleaning tools such as skipper balls, or air sweeps may not be used due to their inability to contact clean all sides of the duct.
 - e. Where ductwork is large enough and able to support the weight of a worker, hand tools and vacuums may be used. If workers enter the inside of the duct, they must follow the OSHA confined space requirements (OSHA 29 CFR 1910.146).
- D. Open Ductwork: During the cleaning process, provide temporary closures of metal or taped polyethylene on open ductwork to prevent the dust during the cleaning process from dispersing throughout the work area.
- E. All lined ductwork is to be encapsulated as applicable.
- 1. Controlling Odors: All responsible measures shall be taken to control any and all offensive odors and/or mist vapors generated during the cleaning process.
 - 2. Containment: Debris removed during the cleaning process shall be collected and tagged as to its origin within the Air Conveyance System (ACS). Precautions must be taken to ensure that debris is not dispersed outside the ACS during the cleaning process.

3.4 CLEANING OF HVAC COMPONENTS

- A. All A/C coils, drain pans, heating coils, humidifiers, fans, registers and grilles to be power washed using a high pressure, low fluid volume equipment. Cleaning to be performed in the steps:
- Using biodegradable industrial type concentrated detergent.
 - Using a concentrated disinfectant, fungicide, odor counteractant, EPA approved material such as Oxine.
- B. Air Handling Unit Surfaces:
- 1. The interior of the air handling units shall be brushed and mechanically vacuumed such that all metal surfaces are visibly clean and capable of Non-Porous Surfaces Cleaning Verification as described in the NADCA Standards. Internally lined ductwork shall be visibly clean, but will not be subject to testing as per NADCA Standards. No cleaning method should be used which could potentially damage components of the ductwork or negatively alter the integrity of the system.
 - 2. Air handling unit cleaning shall include plenums, filter section, mixing boxes, return air fans, dampers and all components not specifically covered by Section 3.4.2.

3. Air handling unit fiberglass lining shall be encapsulated to deter further deterioration and breakdown. Method and type of encapsulating material must be approved by the Project Engineer prior to implementation.
- C. Coil and Fan Section of Air Handling Units: Coils shall be pressure washed and vacuumed such that they are visibly clean and capable of passing Coil Cleaning Verification. Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Certifications as per NADCA Standards. The drain for the condensate pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, or erosion of the coil surface, and shall conform to coil manufacturer recommendations when available.
- D. Ceiling Plenums and Mechanical Rooms: All loose debris shall be removed, and the entire ceiling plenum or mechanical room including, but not limited to, duct exterior, walls, deck, top of ceiling tiles, structural steel, piping, conduit, light fixtures shall be mechanically vacuumed. The plenum or Mechanical Room shall be visibly clean, but will not be subject to verification as per NADCA Standards.
- E. Induction Units: The induction unit covers shall be removed, and the entire unit interior completely brushed and vacuumed. All unit nozzles shall be clean and inspected. The Owner shall be notified of any broken or missing nozzles. Units subject to visual verification only.
- F. VAV Boxes: Disconnect inlet ducts, open access door and completely brush and mechanically vacuum all interior surfaces.
- G. Duct Re-heat Coils: Duct mounted coils shall be hand washed (air or water) on both coil faces. Thoroughly clean coil faces insuring the removal of debris, while avoiding damage to the fins. Remove corrosion from around the coil frames and paint all corroded metal surfaces. Perform pressure differential readings across the coil to verify cleanliness. Final pressure differentials across the coil shall be within 10% of manufacturer's original ratings.
- H. Volume, Fire and Zone Dampers: Duct mounted volume, fire and zone damper sets are to be marked to their current setting, then inspected and cleaned if necessary. External moving parts are to be treated with an approved dry lubricant material. After cleaning, the dampers shall be repaired as necessary to insure proper operation and returned to original settings. Contractor shall indicate locations of damaged and/or repaired dampers.
- I. Grilles, Registers and Diffusers: Whenever the grilles, registers and diffusers (GRD) are removable, they shall be removed, washed, dried, sanitized and replaced. When the GRD are restricted by a facade or welded in place, hand vacuuming and cleaning are acceptable. The Contractor shall avoid disturbing the existing volume damper settings. The Contractor is not responsible for cleaning the debris built-up on the ceiling.

3.5 FINAL INSPECTION

- A. A final check is to be carried out to ensure that no dust or debris remain on surfaces as the result of dismantling operations.
- B. The Project Engineer will thoroughly inspect the place jointly with the Contractor, to determine whether any damage has been done on the finishes, equipment or any other part of the work place. A final inspection report will be prepared jointly between the Project Engineer and the Contractor detailing the list of items to be fixed by the Contractor.

3.6 VERIFICATION

- A. General verification of cleanliness will be determined after Mechanical Cleaning and before the application of any treatment or introduction of any treatment-related substance. Verification of

Non-Porous Surface cleaning and Verification of Coil Cleaning shall be conducted after Mechanical Cleaning and before the system is restored to normal operation.

- B. Verification of Coil Cleaning: Mechanical cleaning must restore the coil-pressure drop to within 10% of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean based on a thorough visual inspection.

3.7 SEQUENCE OF WORK

- A. Since the systems must be operational during the normal work hours, the Contractor shall submit to the Owner a procedure and schedule for cleaning the ductwork and installing filters which will minimize contamination of already cleaned areas. This schedule must be approved by the Owner prior to starting work.

3.8 RESTORATION, REPAIRS AND INSTALLATION

- A. Repair and restore space in accordance with the final inspection list specified herein. If no additional modification of the work space is to take place, re-install all removable equipment and fixtures back in the space.
- B. Any damages to the finishes, floor, walls or any other item or fixture that has been the result of actions by the Contractor personnel is to be repaired to their original condition without any additional costs.
- C. Reinstall existing and install new accessories in accordance with manufacturer's instructions.
- D. Demonstrate resetting of fire and balancing dampers to authorities having jurisdiction and Owner's representative.
- E. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers at fire dampers, and elsewhere if required. Provide suitable size access doors for hand access or shoulder access where necessary.
- F. Reconnect mixing box to ducts. Replace flexible ducts, clamps and gasketing if damaged during removal.
- G. Reconnect diffusers to ducts, replace straps or clamps and flexible duct if damaged during removal.
- H. Repair or replace duct insulation damaged during the work. Materials to match existing.
- I. The Contractor shall replace existing prefilters and filters with new filters for each system as required.

3.10 POST PROJECT REPORT

A post project report must be presented to include digital documentation, findings, recommendations, and success of services provided.

END OF SECTION 23 00 01

**SECTION 23 05 00
COMMON WORK RESULTS FOR MECHANICAL**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Mechanical equipment coordination and installation.
 - 2. Common mechanical installation requirements.
 - 3. Commissioning requirements.

1.3 GENERAL REQUIREMENTS

- A. Carefully examine General Conditions, other specification sections, and other drawings (in addition to DIVISION 23), in order to be fully acquainted with their effect on mechanical work. Additions to the contract cost will not be allowed due to failure to inspect existing conditions.
- B. Do all work in compliance with 2017 6th Edition Florida Building Code, and the Codes adopted therein, and 2017 6th Edition Florida Fire Prevention Code. Obtain and pay for any and all required permits, inspections, certificates of inspections and approval, and the like, and deliver such certificates to the Architect/Engineer.
- C. Cooperate and coordinate with all other trades. Perform work in such manner and at such times as not to delay work of other trades. Complete all work as soon as the condition of the structure and installations of equipment will permit. Patch, in a satisfactory manner and by the proper craft, any work damaged by mechanical workmen.
- D. Furnish, perform, or otherwise provide all labor (including, but not limited to, all planning, purchasing, transporting, rigging, hoisting, storing, installing, testing, chasing, channeling, cutting, trenching, excavating and backfilling), coordination, field verification, equipment installation, support, and safety, supplies, and materials necessary for the correct installation of complete and functional mechanical systems (as described or implied by these specifications and the applicable drawings).

1.4 DRAWINGS:

- A. Indicate only diagrammatically the extent, general character, and approximate location of work. Where work is indicated, but with minor details omitted, furnish and install it complete and so as to perform its intended functions.
- B. DIVISION 23 work called for under any section of the project specifications, shall be considered as included in this work unless specifically excluded by inclusion in some other branch of the work. This shall include roughing-in for connections and equipment as called for or inferred. This shall include connection and ductwork required for all fans, hoods, dryers, diffusers etc as required for a functional installation, whether shown on the drawings or not. Check all drawings and specifications for the project and shall be responsible for the installation of all DIVISION 23 work.
- C. Take finish dimensions at the job site in preference to scaled dimensions. Do not scale drawings where specific details and dimensions for DIVISION 23 work are not shown on the drawings, take measurements and make layouts as required for the proper installation of the work and coordination with all drawings and coordination with all other work on the project. In case of any discrepancies between the drawings and the specifications that have not been clarified by addendum prior to bidding, it shall be assumed by the signing of the contract that the higher cost (if any difference in costs) is included in the contract price, and perform the work in accordance with the drawings or with the specifications, as determined and approved by the Architect/ Engineer, and no additional costs shall be allowed to the base contract price.
- D. Carefully check the drawings and specifications of all trades and divisions before installing any of the work. Contractor shall in all cases consider the work of all other trades, and shall coordinate his work with them so that the best arrangements of all equipment, piping, conduit, ducts, rough-in, etc., can be obtained. The avoidance of any beams, joist or bracing that is an obstruction to ductwork, shall be included in the bid. This includes the reroute of ductwork or dimension revisions required to obtain the intended function of the ductwork. Bring all obstructions to the attention of the A/E during the shop drawing preparation and prior to fabrication of any ductwork. No cost will be paid by the owner for these modifications that can be identified by reviewing all sets of drawings prior to bid.
- E. All equipment and controllers shall have a minimum fault current withstand rating equal to the overcurrent protective device from which it is fed.
- F. All equipment attached to the exterior of the building structure shall carry the Florida Product Approval rating to withstand hurricane force winds in local area. If no product approval rating is standard, the contractor shall get the new approval or have the structural integrity certified by a Florida Registered Structural Engineer to comply with the requirements at no additional cost to the Owner.
- G. Provide appropriately rated fire dampers or fire/smoke dampers as required by code at penetrations of fire rated or smoke rated walls by all duct work including but not limited to air supply, return, exhaust and ventilation ducts. These shall be provided at no additional cost whether shown on the drawings or not.

- H. Carefully examine the route for installation and delivery of all equipment. Contractor shall disassemble and reassemble all items required to deliver and install each piece of equipment or provide for the removal and reinstallation of the impeding item. Provide all field support from manufacturer if required to maintain UL listing, warranty or other manufacturer requirements for the installation of the equipment. Notify the AE prior to bid if there are any issues with this requirement being met.
- I. Provide louvers in generator rooms for the generator whether shown or not. Louver shall be sized for appropriate combustion and cooling required per the manufacturers literature. Include all exhaust piping to take exhaust from muffler to the building exterior and fuel vent to the exterior whether shown or not.
- J. Provide condensate drain lines for all AHU's and FCU's whether shown on drawings or not. Take condensate to the nearest of hub drain, floor drain or exterior dry well if in a concealed area.
- K. Coordinate mechanical equipment voltage requirements with electrical drawings. Notify the A/E of any discrepancies prior to bid. Make all revisions required to coordinate with no additional cost to the owner.
- L. Obtain manufacturer's data on all equipment, the dimensions of which may affect mechanical work. Use this data to coordinate proper service characteristics, entry locations, etc., and to ensure minimum clearances are maintained.

1.5 QUALIFICATIONS OF CONTRACTOR:

- A. DIVISION 23 Contractor shall have had experience of at least the same size and scope as this project, on at least two other projects within the last five years in order to be qualified to bid this project.
- B. Contractor performing any part of this scope of work shall be a Florida State Certified Mechanical Contractor (Type CMC)
- C. Provide field superintendent who has had a minimum of four (4) years previous successful experience on projects of comparable size and complexity. Superintendent shall be on the site at all times during construction.

1.6 SITE VISIT/CONDITIONS

- A. Visit the site of this contract and thoroughly familiarize with all existing field conditions and the proposed work as described or implied by the contract documents. During the course of his site visit, verify every aspect of the proposed work and the existing field conditions in the areas of construction which might affect his work. No compensation or reimbursement for additional expenses incurred due to failure or neglect to make a thorough investigation of the contract documents and the existing site conditions will be permitted.
- B. Install all equipment so that all Code required and Manufacturer recommended servicing clearances are maintained. Coordinate the proper arrangement and

installation of all equipment within any designated space. If it is determined that a departure from the Contract Documents is necessary, submit to the A/E, for approval, detailed drawings of the proposed changes with written reasons for the changes. No changes shall be implemented without the approval of the engineer.

- C. Submission of a proposal will be construed as evidence that such examination has been made and later claims for labor, equipment or materials required because of difficulties encountered will not be recognized.
- D. Existing conditions and utilities indicated are taken from existing construction documents, surveys, and field investigations. Unforeseen conditions probably exist and existing conditions shown on drawings may differ from the actual existing installation with the result being that new work may not be field located exactly as shown on the drawings. Field verify dimensions of all site conditions prior to bidding and include any deviations in the contract. Notify A/E if deviations are found.
- E. All existing mechanical is not shown. Become familiar with all existing conditions prior to bidding, and include in the bid the removal of all mechanical equipment, duct, controls wiring, control devices, and control conduits, etc. that is not being reused, back to it's originating point.
- F. Locate all existing utilities and protect them from damage. Pay for repair or replacement of utilities or other property damaged by operations in conjunction with the completion of this work.
- G. Work is in connection with existing buildings which must remain in operation while work is being performed. Work shall be in accord with the schedule required by the Contract. Schedule work for a minimum shut down to Owner. Notify Owner 72 hours in advance of any shut-down of existing systems. Perform work during non-operating hours unless otherwise accepted by Owner. Protect existing buildings and equipment during construction.

1.7 COMMISSIONING RESPONSIBILITIES

- A. Attend commissioning meetings scheduled by the CM.
- B. Schedule work so that required mechanical installations are completed, and system verification checks and functional performance test can be carried out on schedule.
- C. Inspect, check and confirm in writing the proper installation and performance of all mechanical services as required by the system verification and functional performance testing requirements of mechanical equipment in the commissioning specifications.
- D. Provide qualified personnel to assist and operate mechanical system during system verification checks and functional performance testing of HVAC systems as required by the commissioning specifications.
- E. Provide instruction and demonstrations for the Owner's designated operating staff in accordance with the requirements of the commissioning specifications.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR MECHANICAL INSTALLATION

- A. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- B. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- C. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both mechanical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- D. Right of Way: Give to piping systems installed at a required slope.
- E. All work shall be executed in a workmanship manner and shall present a neat mechanical appearance upon completion.
- F. Care shall be exercised that all items are plumb, straight, level.
- G. Care shall be exercised so that Code clearance is allowed for all panels, controls. etc., requiring it. Do not allow other trades to infringe on this clearance.
- H. The electrical circuits, components and controls for all equipment are selected and sized based on the equipment specified. If substitutions are proposed, furnish all materials and data required to prove equivalence. No additional charges shall be allowed if additional materials, labor, connections or equipment are needed for substituted products. Any modifications to the electrical design and installation or other trades will also need to be made at no additional cost to the Owner to accommodate the proposed substitutions. Comply with division 1 "substitutions" if allowable.
- I. HVAC environmental control of the project area shall be the responsibility of the contractor for the duration of the work. Where the work area affects other parts of the facility, the contractor shall be responsible for coordinating to maintain environmental services to the other parts of the facility.
- J. The work shall not be considered substantially complete until HVAC system controls are complete, functioning, and tested, and HVAC system testing and balancing are complete.

3.2 CONCRETE PADS

- A. Furnish and install reinforced concrete housekeeping pads for all ground mounted AHU's, Pumps, Condensers, ice tanks, chillers, cooling towers and other free-standing equipment. Unless otherwise noted, pads shall be four (4) inches high and shall exceed dimensions of equipment being set on them, including future sections, by three (3) inches each side, except when equipment is flush against a wall where the side against the wall shall be flush with the equipment.

3.3 DEMOLITION

- A. Unless otherwise specified, all equipment and materials shall remain the property of the Owner. Owner shall have first rights to all demolished items if they decide it is usable. This selected property of Owner shall be delivered to a location where directed by Owner within 15 miles of site and all other items shall be removed from the job site and legally disposed of by the Contractor.
- B. Seal all penetrations though walls left vacant due to the removal of mechanical equipment, piping, and ductwork.

END OF SECTION 230500

SECTION 23 05 10
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
 2. Transition fittings.
 3. Dielectric fittings.
 4. Mechanical sleeve seals.
 5. Sleeves.
 6. Escutcheons.
 7. Grout.
 8. Mechanical demolition.
 9. Equipment installation requirements common to equipment sections.
 10. Painting and finishing.
 11. Concrete bases.
 12. Supports and anchorages.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. The following are industry abbreviations for plastic materials:
1. ABS: Acrylonitrile-butadiene-styrene plastic.
 2. CPVC: Chlorinated polyvinyl chloride plastic.

3. PE: Polyethylene plastic.
4. PVC: Polyvinyl chloride plastic.

- G. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-diene terpolymer rubber.
 2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

- A. Product Data: For the following:
1. Transition fittings.
 2. Dielectric fittings.
 3. Mechanical sleeve seals.
 4. Escutcheons.
- B. Welding certificates.

1.5 QUALITY ASSURANCE

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

1.6 DELIVERY, STORAGE, AND HANDLING

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

1.7 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the manufacturers specified.
 - 2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
- H. Solvent Cements for Joining Plastic Piping:
 - 1. CPVC Piping: ASTM F 493.
 - 2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - 3. PVC to ABS Piping Transition: ASTM D 3138.

2.4 TRANSITION FITTINGS

- A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.
 - 1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Dresser Industries, Inc.; DMD Div.
 - c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
 - d. JCM Industries.
 - e. Smith-Blair, Inc.
 - f. Viking Johnson.
 - 2. Underground Piping **NPS 1-1/2 (DN 40)** and Smaller: Manufactured fitting or coupling.
 - 3. Underground Piping **NPS 2 (DN 50)** and Larger: AWWA C219, metal sleeve-type coupling.
 - 4. Aboveground Pressure Piping: Pipe fitting.
- B. Plastic-to-Metal Transition Fittings: CPVC and PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Eslon Thermoplastics.
- C. Plastic-to-Metal Transition Adaptors: One-piece fitting with manufacturer's SDR 11 equivalent dimensions; one end with threaded brass insert, and one solvent-cement-joint end.
 - 1. Manufacturers:
 - a. Thompson Plastics, Inc.
- D. Plastic-to-Metal Transition Unions: MSS SP-107, CPVC and PVC four-part union. Include brass end, solvent-cement-joint end, rubber O-ring, and union nut.
 - 1. Manufacturers:
 - a. NIBCO INC.
 - b. NIBCO, Inc.; Chemtrol Div.
- E. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:
 - a. Cascade Waterworks Mfg. Co.
 - b. Fernco, Inc.
 - c. Mission Rubber Company.
 - d. Plastic Oddities, Inc.

2.5 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig (1725-kPa) minimum working pressure at 180 deg F (82 deg C).
 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.
 - f. Watts Industries, Inc.; Water Products Div.
 - g. Zurn Industries, Inc.; Wilkins Div.
- D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig (1035- or 2070-kPa) minimum working pressure as required to suit system pressures.
 1. Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Epco Sales, Inc.
 - d. Watts Industries, Inc.; Water Products Div.
- E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
 1. Manufacturers:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Central Plastics Company.
 - d. Pipeline Seal and Insulator, Inc.
 2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig (1035- or 2070-kPa) minimum working pressure where required to suit system pressures.
- F. Dielectric Couplings: Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 1. Manufacturers:
 - a. Calpico, Inc.

- b. Lochinvar Corp.
- G. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig (2070-kPa) minimum working pressure at 225 deg F (107 deg C).
 - 1. Manufacturers:
 - a. Perfection Corp.
 - b. Precision Plumbing Products, Inc.
 - c. Sioux Chief Manufacturing Co., Inc.
 - d. Victaulic Co. of America.

2.6 MECHANICAL SLEEVE SEALS

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

2.7 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

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

2.9 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.

- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas **2 inches (50 mm)** above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide **1/4-inch (6.4-mm)** annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than **NPS 6 (DN 150)**.
 - b. Steel Sheet Sleeves: For pipes **NPS 6 (DN 150)** and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to **2 inches (50 mm)** above finished floor level. Refer to Division 7 Section "Sheet Metal Flashing and Trim" for flashing.
 - 1) Seal space outside of sleeve fittings with grout.
 - 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and

location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

- N. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Install steel pipe for sleeves smaller than 6 inches (150 mm) in diameter.
 - 2. Install cast-iron "wall pipes" for sleeves 6 inches (150 mm) and larger in diameter.
 - 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- O. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.
 - 1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- P. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Refer to Division 7 Section "Firestopping" for materials and installation.
- Q. Verify final equipment locations for roughing-in.
- R. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.
- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping **NPS 2 (DN 50)** and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping **NPS 2-1/2 (DN 65)** and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

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

3.5 PAINTING

- A. Painting of mechanical systems, equipment, and components is specified in Division 9.
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than **4 inches (100 mm)** larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on **18-inch (450-mm)** centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use **3000-psi (20.7-MPa)**, 28-day compressive-strength concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete."

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

- C. Field Welding: Comply with AWS D1.1.

3.8 ERECTION OF WOOD SUPPORTS AND ANCHORAGES

- A. Cut, fit, and place wood grounds, nailers, blocking, and anchorages to support, and anchor mechanical materials and equipment.
- B. Select fastener sizes that will not penetrate members if opposite side will be exposed to view or will receive finish materials. Tighten connections between members. Install fasteners without splitting wood members.
- C. Attach to substrates as required to support applied loads.

3.9 GROUTING

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

END OF SECTION 230510

SECTION 23 05 13 COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
- B. Comply with NEMA MG 1 unless otherwise indicated.
- C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with

indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Energy efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Rotor: Random-wound, squirrel cage.
- F. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- G. Temperature Rise: Match insulation rating.
- H. Insulation: Class F.
- I. Code Letter Designation:
 - 1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
 - 2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.
- J. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.
 - 5. Provide VFD driven motors with shaft grounding.
- B. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 230513

SECTION 23 05 17
SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Sleeves.
 - 2. Sleeve-seal systems.
 - 3. Grout.

1.3 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Galvanized-Steel Wall Pipes: ASTM A 53/A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
- B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
- C. Galvanized-Steel-Sheet Sleeves: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.
- D. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.

3. Metraflex Company (The).
4. Pipeline Seal and Insulator, Inc.
5. Proco Products, Inc.

- B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 2. Pressure Plates: Carbon steel.
 3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION

- A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, and walls.
- B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch (25-mm) annular clear space between piping and concrete slabs and walls.
1. Sleeves are not required for core-drilled holes.
- C. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 2. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches (50 mm) above finished floor level.
 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- D. Install sleeves for pipes passing through interior partitions.
1. Cut sleeves to length for mounting flush with both surfaces.

2. Install sleeves that are large enough to provide 1/4-inch (6.4-mm) annular clear space between sleeve and pipe or pipe insulation.
 3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."
- E. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at service piping entries into building.
- B. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.
 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch (25-mm) annular clear space between piping and sleeve for installing sleeve-seal system.
 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-pipe sleeves.

5. Interior Partitions:
 - a. Piping Smaller Than NPS 6 (DN 150): Galvanized-steel-pipe sleeves.
 - b. Piping NPS 6 (DN 150) and Larger: Galvanized-steel-sheet sleeves.

END OF SECTION 230517

SECTION 23 05 19 METERS AND GAGES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following meters and gages for mechanical systems:
 - 1. Thermometers.
 - 2. Gages.
 - 3. Test plugs.
 - 4. Flowmeters.
 - 5. Thermal-energy meters.

1.3 DEFINITIONS

- A. CR: Chlorosulfonated polyethylene synthetic rubber.
- B. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated; include performance curves.
- B. Shop Drawings: Schedule for thermometers, gages and flowmeters indicating manufacturer's number, scale range, and location for each.
- C. Product Certificates: For each type of thermometer, gage and flowmeter, signed by product manufacturer.
- D. Operation and Maintenance Data: For flowmeters and thermal-energy meters to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 1. Palmer - Wahl Instruments Inc.
 2. Terice, H. O. Co.
 3. Weiss Instruments, Inc.
 4. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
- B. Case: Die-cast aluminum or brass, 7 inches long.
- C. Tube: blue reading, organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic .
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS

- A. Manufacturers:
 1. Ernst Gage Co.
 2. Eugene Ernst Products Co.
 3. Marsh Bellofram.
 4. Miljoco Corp.
 5. Terice, H. O. Co.
 6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
 7. Winters Instruments.
- B. Case: Plastic, 7 inches long.
- C. Tube: Blue reading organic-liquid filled, with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

- E. Window: Glass or plastic.
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.
- G. Stem: Metal, for thermowell installation and of length to suit installation.
- H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 DUCT-TYPE, LIQUID-IN-GLASS THERMOMETERS

- A. Available Manufacturers:
 - 1. Miljoco Corp.
 - 2. Palmer - Wahl Instruments Inc.
 - 3. Trerice, H. O. Co.
 - 4. Weiss Instruments, Inc.
- B. Case: Die-cast aluminum , 7 inches long.
- C. Tube: blue reading organic-liquid filled with magnifying lens.
- D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.
- E. Window: Glass or plastic .
- F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device .
- G. Stem: Metal, for installation in mounting bracket and of length to suit installation.
- H. Mounting Bracket: Flanged fitting for attachment to duct and made to hold thermometer stem.
- I. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.5 THERMOWELLS

- A. Available Manufacturers:
 - 1. AMETEK, Inc.; U.S. Gauge Div.
 - 2. Ernst Gage Co.
 - 3. .
 - 4. Tel-Tru Manufacturing Company.
 - 5. Weiss Instruments, Inc.
 - 6. Winters Instruments.
- B. Manufacturers: Same as manufacturer of thermometer being used.

- C. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer.

2.6 PRESSURE GAGES

- A. Available Manufacturers:
1. AMETEK, Inc.; U.S. Gauge Div.
 2. Ernst Gage Co.
 3. Eugene Ernst Products Co.
 4. KOBOLD Instruments, Inc.
 5. Weiss Instruments, Inc.
 6. Winters Instruments.
- B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.
1. Case: Liquid-filled type, drawn steel or cast aluminum , 4-1/2-inch diameter.
 2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
 3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
 4. Movement: Mechanical, with link to pressure element and connection to pointer.
 5. Dial: Satin-faced, nonreflective aluminum with permanently etched scale markings.
 6. Pointer: Red metal.
 7. Window: Glass or plastic.
 8. Ring: Metal Brass Stainless steel.
 9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
 10. Vacuum-Pressure Range: 30-in. Hg of vacuum to 15 psig of pressure.
 11. Range for Fluids under Pressure: Two times operating pressure.
- C. Pressure-Gage Fittings:
1. Valves: NPS 1/4 brass or stainless-steel needle type.
 2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
 3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.7 TEST PLUGS

- 1.
- B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
- C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- D. Core Inserts: One or two self-sealing rubber valves.
1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be CR.
 2. Insert material for air or water service at minus 30 to plus 275 deg F shall be EPDM.

- E. Test Kit: Furnish one test kit(s) containing one pressure gage and adaptor, two thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping. Manufacturer: Peterson Equipment Co., Inc, Model 1500
1. Pressure Gage: Small bourdon-tube insertion type with **2- to 3-inch-** diameter dial and probe. Dial range shall be **0 to 200 psig** .
 2. Low-Range Thermometer: Small bimetallic insertion type with **1- to 2-inch-** diameter dial and tapered-end sensing element. Dial ranges shall be **25 to 125 deg F** .
 3. High-Range Thermometer: Small bimetallic insertion type with **1- to 2-inch-** diameter dial and tapered-end sensing element. Dial ranges shall be **0 to 220 deg F** .
 4. Carrying case shall have formed instrument padding.
 5. Kit shall be per national and OCPS standards.

2.8 WAFER-ORIFICE FLOWMETERS

- A. Available Manufacturers:
1. ABB, Inc.; ABB Instrumentation.
 2. Armstrong Pumps, Inc.
 3. Badger Meter, Inc.; Industrial Div.
 4. Bell & Gossett; ITT Industries.
 5. Meriam Instruments Div.; Scott Fetzer Co.
- B. Description: Differential-pressure-design orifice insert for installation between pipe flanges; with calibrated flow-measuring element, separate flowmeter, hoses or tubing, valves, fittings, and conversion chart compatible with flow-measuring element, flowmeter, and system fluid.
- C. Construction: Cast-iron body, brass valves with integral check valves and caps, and calibrated nameplate.
- D. Pressure Rating: **300 psig** .
- E. Temperature Rating: **250 deg F** .
- F. Range: Flow range of flow-measuring element and flowmeter shall cover operating range of equipment or system served.
- G. Permanent Indicators: Suitable for wall or bracket mounting, calibrated for connected flowmeter element, and having **6-inch-** diameter, or equivalent, dial with fittings and copper tubing for connecting to flowmeter element.
1. Scale: **Gallons per minute**.
 2. Accuracy: Plus or minus 1 percent between 20 and 80 percent of range.
- H. Portable Indicators: Differential-pressure type calibrated for connected flowmeter element and having two **12-foot** hoses in carrying case.
1. Scale: **Gallons per minute**.
 2. Accuracy: Plus or minus 2 percent between 20 and 80 percent of range.

- I. Operating Instructions: Include complete instructions with each flowmeter.

2.9 FLOW INDICATORS

- A. Available Manufacturers:
 - 1. Brooks Instrument Div.; Emerson Electric Co.
 - 2. Dwyer Instruments, Inc.
 - 3. Ernst Gage Co.
 - 4. Eugene Ernst Products Co.
 - 5. McCrometer, Inc.
 - 6. OPW Engineered Systems; Dover Corp.
 - 7. Penberthy, Inc.
- B. Description: Instrument for installation in piping systems for visual verification of flow.
- C. Construction: Bronze or stainless-steel body; with sight glass and plastic pelton-wheel indicator, and threaded or flanged ends.
- D. Pressure Rating: 125 psig .
- E. Temperature Rating: [200 deg F] .
- F. End Connections for NPS 2 and Smaller: Threaded.
- G. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

- A. Install liquid-in-glass thermometers in the following locations:
 - 1. Inlet and outlet of each hydronic zone.
 - 2. Inlet and outlet of each hydronic chiller.
 - 3. Inlet and outlet of each hydronic coil in air-handling units and built-up central systems.
 - 4. Outside-air, return-air, and mixed-air ducts.
- B. Provide the following temperature ranges for thermometers:
 - 1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions .
 - 2. Chilled Water: 0 to 100 deg F, with 2-degree scale divisions .

3.2 GAGE APPLICATIONS

- A. Install dry-case-type pressure gages for discharge of each pressure-reducing valve.
- B. Install liquid-filled-case-type pressure gages at chilled- -water inlets and outlets of chillers.

- C. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

3.3 INSTALLATIONS

- A. Install direct-mounting thermometers and adjust vertical and tilted positions.
- B. Install remote-mounting dial thermometers on panel, with tubing connecting panel and thermometer bulb supported to prevent kinks. Use minimum tubing length.
- C. Install thermowells with socket extending a minimum of **2 inches** into fluid and in vertical position in piping tees where thermometers are indicated.
- D. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.
- E. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.
- F. Install remote-mounting pressure gages on panel.
- G. Install needle-valve and snubber fitting in piping for each pressure gage for fluids (except steam).
- H. Install test plugs in tees in piping.
- I. Install flow indicators, in accessible positions for easy viewing, in piping systems.
- J. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.
- K. Install flowmeter elements in accessible positions in piping systems.
- L. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.
- M. Install wafer-orifice flowmeter elements between pipe flanges.
- N. Install permanent indicators on walls or brackets in accessible and readable positions.
- O. Install connection fittings for attachment to portable indicators in accessible locations.
- P. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.
- Q. Assemble components and install thermal-energy meters.
- R. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.
- B. Connect flowmeter-system elements to meters.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.5 ADJUSTING

- A. Calibrate meters according to manufacturer's written instructions, after installation.
- B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 230519

SECTION 23 05 23 VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following general-duty valves:
 - 1. Copper-alloy ball valves.
 - 2. Ferrous-alloy ball valves.
 - 3. Ferrous-alloy butterfly valves.
 - 4. Bronze check valves.

1.3 DEFINITIONS

- A. The following are standard abbreviations for valves:
 - 1. CWP: Cold working pressure.
 - 2. EPDM: Ethylene-propylene-diene terpolymer rubber.
 - 3. PTFE: Polytetrafluoroethylene plastic.
 - 4. SWP: Steam working pressure.
 - 5. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

- A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE

- A. ASME Compliance: ASME B31.9 for building services piping valves.
 - 1. Exceptions: Domestic hot- and cold-waterpiping valves unless referenced.
- B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.
- C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, grooves, and weld ends.
 - 3. Set angle and globe valves closed to prevent rattling.
 - 4. Set ball and plug valves open to minimize exposure of functional surfaces.
 - 5. Set butterfly valves closed or slightly open.
 - 6. Block check valves in either closed or open position.
- B. Use the following precautions during storage:
 - 1. Maintain valve end protection.
 - 2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

- A. Refer to Part 3 "Valve Applications" Article for applications of valves.
- B. Bronze Valves: **NPS 2 (DN 50)** and smaller with threaded ends, unless otherwise indicated.
- C. Ferrous Valves: **NPS 2-1/2 (DN 65)** and larger with flanged ends, unless otherwise indicated.
- D. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.
- E. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
- F. Valve Actuators:
 - 1. Gear Drive: For quarter-turn valves **NPS 8 (DN 200)** and larger.
 - 2. Handwheel: For valves other than quarter-turn types.
 - 3. Lever Handle: For quarter-turn valves **NPS 6 (DN 150)** and smaller, except plug valves.
- G. Extended Valve Stems: On insulated valves.
- H. Valve Flanges: ASME B16.1 for cast-iron valves, ASME B16.5 for steel valves, and ASME B16.24 for bronze valves.
- I. Valve Grooved Ends: AWWA C606.
 - 1. Solder Joint: With sockets according to ASME B16.18.

- a. Caution: Use solder with melting point below 840 deg F (454 deg C) for angle, check and globe valves; below 421 deg F (216 deg C) for ball valves.
- 2. Threaded: With threads according to ASME B1.20.1.
- J. Valve Bypass and Drain Connections: MSS SP-45.

2.2 COPPER-ALLOY BALL VALVES

- A. Copper-Alloy Ball Valves, General: MSS SP-110.
- B. Two-Piece, Copper-Alloy Ball Valves: Brass or bronze body with full or regular-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig (4140-kPa) minimum CWP rating and blowout-proof stem.

2.3 FERROUS-ALLOY BALL VALVES

- A. Ferrous-Alloy Ball Valves, General: MSS SP-72, with flanged ends.
- B. Ferrous-Alloy Ball Valves: Class 150, full or regular port.

2.4 FERROUS-ALLOY BUTTERFLY VALVES

- A. Ferrous-Alloy Butterfly Valves, General: MSS SP-67, Type I, for tight shutoff, with disc and lining suitable for potable water, unless otherwise indicated.
- B. Flanged, 200-psig (1380-kPa) CWP Rating, Ferrous-Alloy Butterfly Valves: Flanged-end type with one- or two-piece stem.

2.5 BRONZE CHECK VALVES

- A. Bronze Check Valves, General: MSS SP-80.
- B. Type 2, Class 125, Bronze, Horizontal Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
- C. Type 2, Class 125, Bronze, Vertical Lift Check Valves: Bronze body with nonmetallic disc and bronze seat.
- D. Type 2, Class 125, Bronze, Spring Check Valves: Bronze body with nonmetallic disc, stainless steel spring, and bronze seat.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
 - 1. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- D. Examine threads on valve and mating pipe for form and cleanliness.
- E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

- A. Refer to piping Sections for specific valve applications. If valve applications are not indicated, use the following:
 - 1. Shutoff Service: Ball or butterfly valves.
 - 2. Throttling Service: Angle, ball, butterfly, or globe valves.
- B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.
- C. Chilled-Water Piping: Use the following types of valves:
 - 1. Ball Valves, **NPS 2 (DN 50)** and Smaller: **Two-piece, 600-psig (4140-kPa)** CWP rating, copper alloy.
 - 2. Ball Valves, **NPS 2-1/2 (DN 65)** and Larger: Class 150, ferrous alloy.
 - 3. Butterfly Valves, **NPS 2-1/2 (DN 65)** and Larger: Flanged, **200-psig (1380-kPa)** CWP rating, ferrous alloy, with EPDM liner.
- D. Select valves, except wafer and flangeless types, with the following end connections:
 - 1. For Copper Tubing, **NPS 2 (DN 50)** and Smaller: Solder-joint or threaded ends.
 - 2. For Copper Tubing, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged or threaded ends.
 - 3. For Copper Tubing, **NPS 5 (DN 125)** and Larger: Flanged ends.
 - 4. For Steel Piping, **NPS 2 (DN 50)** and Smaller: Threaded ends.
 - 5. For Steel Piping, **NPS 2-1/2 to NPS 4 (DN 65 to DN 100)**: Flanged or threaded ends.
 - 6. For Steel Piping, **NPS 5 (DN 125)** and Larger: Flanged ends.
 - 7. For Grooved-End, Copper Tubing and Steel Piping: Valve ends may be grooved.

3.3 VALVE INSTALLATION

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.
- C. Locate valves for easy access and provide separate support where necessary.
- D. Install valves in horizontal piping with stem at or above center of pipe.
- E. Install valves in position to allow full stem movement.

3.4 JOINT CONSTRUCTION

- A. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.
- B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.5 ADJUSTING

- A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 230523

**SECTION 23 05 29
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Metal pipe hangers and supports.
 - 2. Trapeze pipe hangers.
 - 3. Metal framing systems.
 - 4. Thermal-hanger shield inserts.
 - 5. Fastener systems.
 - 6. Pipe stands.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Hangers and supports for HVAC piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.
 - 1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
 - 2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details and include calculations for the following; include Product Data for components:
 - 1. Trapeze pipe hangers.
 - 2. Metal framing systems.
 - 3. Pipe stands.
- C. Welding certificates.

1.6 QUALITY ASSURANCE

- A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

- A. Carbon-Steel Pipe Hangers and Supports:
 - 1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
 - 2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
 - 3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
 - 4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
 - 5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.

2.2 TRAPEZE PIPE HANGERS

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

2.3 METAL FRAMING SYSTEMS

- A. Non-MFMA Manufacturer Metal Framing Systems:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Anvil International; a subsidiary of Mueller Water Products Inc.
 - b. Empire Industries, Inc.
 - c. ERICO International Corporation.
 - d. Haydon Corporation; H-Strut Division.
 - e. PHD Manufacturing, Inc.
 - f. PHS Industries, Inc.
 - 2. Description: Shop- or field-fabricated pipe-support assembly made of steel channels, accessories, fittings, and other components for supporting multiple parallel pipes.
 - 3. Standard: Comply with MFMA-4.
 - 4. Channels: Continuous slotted steel channel with intumed lips.
 - 5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
 - 6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel.
 - 7. Coating: Zinc.

2.4 THERMAL-HANGER SHIELD INSERTS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Carpenter & Paterson, Inc.
 - 2. Clement Support Services.
 - 3. ERICO International Corporation.
 - 4. National Pipe Hanger Corporation.
 - 5. PHS Industries, Inc.
 - 6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
 - 7. Piping Technology & Products, Inc.
 - 8. Rilco Manufacturing Co., Inc.
 - 9. Value Engineered Products, Inc.
- B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig (688-kPa) or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig (862-kPa) minimum compressive strength and vapor barrier.
- C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
- D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.
- E. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

- A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.
- B. High-Type, Single-Pipe Stand:
 - 1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Stainless steel.
 - 3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.

4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.
- C. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
 2. Bases: One or more; plastic.
 3. Vertical Members: Two or more protective-coated-steel channels.
 4. Horizontal Member: Protective-coated-steel channel.
 5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.7 MISCELLANEOUS MATERIALS

- A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.
- B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.
1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
 2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.
- E. Fastener System Installation:
1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches (100 mm) thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool

- manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- F. Pipe Stand Installation:
1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
- G. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. Install lateral bracing with pipe hangers and supports to prevent swaying.
- J. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, **NPS 2-1/2 (DN 65)** and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- K. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- L. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.
- M. Insulated Piping:
1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.
 2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe **NPS 4 (DN 100)** and larger if pipe is installed on rollers.
 4. Shield Dimensions for Pipe: Not less than the following:

- a. NPS 1/4 to NPS 3-1/2 (DN 8 to DN 90): 12 inches (305 mm) long and 0.048 inch (1.22 mm) thick.
 - b. NPS 4 (DN 100): 12 inches (305 mm) long and 0.06 inch (1.52 mm) thick.
 - c. NPS 5 and NPS 6 (DN 125 and DN 150): 18 inches (457 mm) long and 0.06 inch (1.52 mm) thick.
 - d. NPS 8 to NPS 14 (DN 200 to DN 350): 24 inches (610 mm) long and 0.075 inch (1.91 mm) thick.
 - e. NPS 16 to NPS 24 (DN 400 to DN 600): 24 inches (610 mm) long and 0.105 inch (2.67 mm) thick.
5. Pipes NPS 8 (DN 200) and Larger: Include wood or reinforced calcium-silicate-insulation inserts of length at least as long as protective shield.
 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 METAL FABRICATIONS

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

3.3 ADJUSTING

- A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.
- B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches (40 mm).

3.4 PAINTING

- A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils (0.05 mm).

- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.5 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.
- C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.
- D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- E. Use carbon-steel pipe hangers and supports and attachments for general service applications.
- F. Use padded hangers for piping that is subject to scratching.
- G. Use thermal-hanger shield inserts for insulated piping and tubing.
- H. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes **NPS 1/2 to NPS 30 (DN 15 to DN 750)**.
 - 2. Pipe Stanchion Saddles (MSS Type 37): For support of pipes **NPS 4 to NPS 36 (DN 100 to DN 900)**, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
- I. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers **NPS 3/4 to NPS 24 (DN 24 to DN 600)**.
- J. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 - 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joint construction, to attach to top flange of structural shape.
 - 3. C-Clamps (MSS Type 23): For structural shapes.
- K. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
 - 1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.

- L. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- M. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- N. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 230529

SECTION 23 05 48
VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Isolation pads.
 - 2. Isolation mounts.
 - 3. Freestanding and restrained spring isolators.
 - 4. Spring hangers.
 - 5. Inertia, vibration isolation equipment bases.

1.3 DEFINITIONS

- A. IBC: International Building Code.
- B. ICC-ES: ICC-Evaluation Service.
- C. OSHPD: Office of Statewide Health Planning and Development for the State of California.

1.4 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 120 MPH.
 - 2. Building Classification Category: III.
 - 3. Minimum 10 lb/sq. ft. (48.8 kg/sq. m) multiplied by the maximum area of the HVAC component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

1.5 SUBMITTALS

- A. Product Data: For the following:
 - 1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
 - 2. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

- B. Delegated-Design Submittal: For vibration isolation and seismic-restraint details indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate static and dynamic loading due to equipment weight and operation, wind forces required to select vibration isolators, wind restraints, and for designing vibration isolation bases.
 - a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Division 22 Sections for equipment mounted outdoors.
 - 2. Vibration Isolation Base Details: Detail overall dimensions, 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.
- C. Qualification Data: For professional engineer.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATORS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Ace Mounting Company Inc.
 - 2. Kinetics Noise Control.
 - 3. Mason Industries.
- B. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment.
 - 1. Resilient Material: Oil- and water-resistant neoprene.
- C. Mounts: Double-deflection type, with molded, oil-resistant rubber, hermetically sealed compressed fiberglass, or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.
 - 1. Materials: Cast-ductile-iron or welded steel housing containing two separate and opposing, oil-resistant rubber or neoprene elements that prevent central threaded element and attachment hardware from contacting the housing during normal operation.
 - 2. Neoprene: Shock-absorbing materials compounded according to the standard for bridge-bearing neoprene as defined by AASHTO.

- D. Spring Isolators: Freestanding, laterally stable, open-spring isolators.
1. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 2. Minimum Additional Travel: 50 percent of the 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- (6-mm-) thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 500 psig (3447 kPa).
 6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.
- E. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic or limit-stop restraint.
1. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to weight being removed; factory-drilled baseplate bonded to 1/4-inch- (6-mm-) thick, neoprene or rubber isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.
 2. Restraint: Seismic or limit stop as required for equipment and authorities having jurisdiction.
 3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 5. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
 6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
- F. 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 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.
 2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 3. Minimum Additional Travel: 50 percent of the 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. Self-centering hanger rod cap to ensure concentricity between hanger rod and support spring coil.

2.2 VIBRATION ISOLATION EQUIPMENT BASES

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Kinetics Noise Control.
 2. Mason Industries.
- B. Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for placement of cast-in-place concrete.
1. Design Requirements: Lowest possible mounting height with not less than **1-inch (25-mm)** clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
 - a. Include supports for suction and discharge elbows for pumps.
 2. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 3. Support Brackets: Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.
 4. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

2.3 FACTORY FINISHES

- A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
1. Powder coating on springs and housings.
 2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
 3. Baked enamel or powder coat for metal components on isolators for interior use.
 4. Color-code or otherwise mark vibration isolation control devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and wind-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Comply with requirements in Division 07 Section "Roof Accessories" for installation of roof curbs, equipment supports, and roof penetrations.

- B. Equipment Restraints:
 - 1. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch (3.2 mm).
- C. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

3.3 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 230548

SECTION 23 05 53
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Equipment labels.
 - 2. Pipe labels.
 - 3. Duct labels.
 - 4. Valve tags.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.
- C. Valve numbering scheme.
- D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

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

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch** thick, and having predrilled holes for attachment hardware.
 2. Letter Color: White.
 3. Background Color: Black.
 4. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.
 5. Minimum Label Size: Length and width vary for required label content, but not less than **2-1/2 by 3/4 inch**.
 6. Minimum Letter Size: **1/4 inch** for name of units if viewing distance is less than **24 inches**, **1/2 inch** for viewing distances up to **72 inches**, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 7. Fasteners: Stainless-steel rivets or self-tapping screws.
 8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules).
- C. Equipment Label Schedule: For each item of equipment to be labeled, on **8-1/2-by-11-inch** bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.
- B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.
- C. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
 2. Lettering Size: At least **1-1/2 inches**.

2.3 DUCT LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, **1/16 inch** thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Per section 3.4.
- D. Maximum Temperature: Able to withstand temperatures up to **160 deg F**.

- E. Minimum Label Size: Length and width vary for required label content, but not less than 4 by 2-4 inch.
- F. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- G. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
 - 1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
 - 2. Lettering Size: At least 1-1/2 inches.

2.4 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.032-inch or anodized aluminum, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass wire-link or beaded chain; or S-hook.
- B. Valve Schedules and Diagram: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Provide diagram of all valves in system on 11-by-17-inch bond paper. Mark valves for emergency shutoff and similar special uses.
 - 1. Valve-tag schedule shall be included in operation and maintenance data.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Install or permanently fasten labels on each major item of mechanical equipment.
- B. Locate equipment labels where accessible and visible.
- C. When equipment is located above the ceiling install label on the ceiling grid T-bar below the equipment and on equipment.

3.3 PIPE LABEL INSTALLATION

- A. Piping Color-Coding: Painting of piping is specified in Division 09.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of **50 feet** along each run. Reduce intervals to **25 feet** in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.
- C. Pipe Label Color Schedule:
 - 1. Chilled-Water Piping:
 - a. Background Color: Green.
 - b. Letter Color: White.
 - 2. Condenser-Water Piping:
 - a. Background Color: Blue.
 - b. Letter Color: White.
 - 3. Refrigerant Piping:
 - a. Background Color: Black.
 - b. Letter Color: White
 - 4. Gas Piping.
 - a. Background Color: Yellow.
 - b. Letter Color: Black.

3.4 DUCT LABEL INSTALLATION

- A. Install duct labels with permanent adhesive on air ducts in the following color codes:
 - 1. Blue: For cold-air supply ducts.
 - 2. Yellow: For hot-air supply ducts.
 - 3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
 - 4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
- B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of **50 feet** in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
1. Valve-Tag Size and Shape:
 - a. Chilled Water: 1-1/2 inches, round.
 - b. Condenser Water: 1-1/2 inches, round.
 - c. Gas: 1-1/2 inches, round.
 2. Valve-Tag Color:
 - a. Chilled Water: Natural.
 - b. Condenser Water: Natural.
 - c. Gas: Yellow.
 3. Letter Color:
 - a. Chilled Water: Black.
 - b. Condenser Water: Black.
 - c. Gas: Black.

END OF SECTION 230553

SECTION 23 05 93
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 2. Hydronic Piping Systems:
 - a. Variable-flow systems.
 3. HVAC equipment quantitative-performance settings.
 4. Kitchen hood airflow balancing.
 5. Vibration measuring.
 6. Indoor-air quality measuring.
 7. Verifying that automatic control devices are functioning properly.
 8. Reporting results of activities and procedures specified in this Section.

1.3 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 indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. 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 person's skin than is normally dissipated.
- E. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- F. Report Forms: Test data sheets for recording test data in logical order.

- G. 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.
- H. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.
- I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- J. 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.
- K. TAB: Testing, adjusting, and balancing.
- L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 45 days from Contractor's Notice to Proceed, submit **6** copies of the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 2 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.
- D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.
- E. Sample Report Forms: Submit two sets of sample TAB report forms.
- F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

- B. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
- C. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
- D. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems."
- E. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
 - 1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

- A. Owner Occupancy: Owner will not occupy the building during entire TAB period. T&B reports shall be finalized and approved prior to owner occupancy.
- B. T&B firm shall be independent from the mechanical contractor.

1.7 COORDINATION

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

1.8 WARRANTY

- A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems", or NEBB's Quality Assurance Program, forms stating that AABC, or NEBB, forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - 1. The certified TAB firm has tested and balanced systems according to the Contract Documents.

2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 2. Verify that balancing devices, such as test ports, gage 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.
- B. Examine approved submittal data of HVAC systems and equipment.
- C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."
- D. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine 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 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.
- F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- G. Examine system and equipment test reports.
- H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and

that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

- I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.
- M. Examine strainers for clean screens and proper perforations.
- N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.
- O. Examine system pumps to ensure absence of entrained air in the suction piping.
- P. Examine equipment for installation and for properly operating safety interlocks and controls.
- Q. Examine automatic temperature system components to verify the following:
 - 1. Dampers, valves, and other controlled devices are operated 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 two-way valves and three-way mixing and diverting valves, are properly connected.
 - 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, 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 indicated values.
 - 9. Interlocked systems are operating.
 - 10. Changeover from heating to cooling mode occurs according to indicated values.
- R. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
 - 1. Permanent electrical power wiring is complete.
 - 2. Hydronic systems are filled, clean, and free of air.
 - 3. Automatic temperature-control systems are operational.
 - 4. Equipment and duct access doors are securely closed.
 - 5. Balance, smoke, and fire dampers are open.
 - 6. Isolating and balancing valves are open and control valves are operational.
 - 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
 - 8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing Adjusting and Balancing of Environmental Systems" and this Section.
- B. 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 insulation Specifications for this Project.
- C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts.
- C. For variable-air-volume systems, develop a plan to simulate diversity.
- D. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- E. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.

- F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- G. Verify that motor starters are equipped with properly sized thermal protection.
- H. Check dampers for proper position to achieve desired airflow path.
- I. Check for airflow blockages.
- J. Check condensate drains for proper connections and functioning.
- K. Check for proper sealing of air-handling unit components.
- L. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure 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 component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
- B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated airflow.
 - 4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 - 5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.

- a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
 6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
 7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
 8. Record the final fan performance data.
- C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Balance systems similar to constant-volume air systems.
 2. Set terminal units and supply fan at full-airflow condition.
 3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 4. Readjust fan airflow for final maximum readings.
 5. Measure operating static pressure at the sensor that controls the supply fan, if one is installed, and verify operation of the static-pressure controller.
 6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
 7. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow as described for constant-volume air systems.
 - a. If air outlets are out of balance at minimum airflow, report the condition but leave the outlets balanced for maximum airflow.
 8. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.
- D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.
 2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
 3. Set terminal units at full-airflow condition.
 4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 5. Adjust terminal units for minimum airflow.
 6. Measure static pressure at the sensor.
 7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.
- B. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 - 1. Open all manual valves for maximum flow.
 - 2. Check expansion tank liquid level.
 - 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 - 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 - 5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
 - 6. Set system controls so automatic valves are wide open to heat exchangers.
 - 7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
 - 8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 - 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
 - 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 - 4. Report flow rates that are not within plus or minus 5 percent of design.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 - 1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

- A. Balance systems with automatic two- and three-way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.10 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
1. Manufacturer, model, and serial numbers.
 2. Motor horsepower rating.
 3. Motor rpm.
 4. Efficiency rating.
 5. Nameplate and measured voltage, each phase.
 6. Nameplate and measured amperage, each phase.
 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.11 PROCEDURES FOR CHILLERS

- A. Balance water flow through each evaporator to within specified tolerances of indicated flow with all pumps operating. With only one chiller operating in a multiple chiller installation, do not exceed the flow for the maximum tube velocity recommended by the chiller manufacturer. Measure and record the following data with each chiller operating at design conditions:
1. Evaporator-water entering and leaving temperatures, pressure drop, and water flow.
 2. .
 3. Evaporator and condenser refrigerant temperatures and pressures, using instruments furnished by chiller manufacturer.

4. Power factor if factory-installed instrumentation is furnished for measuring kilowatt.
5. Kilowatt input if factory-installed instrumentation is furnished for measuring kilowatt.
6. Capacity: Calculate in tons of cooling.
7. If air-cooled chillers, verify condenser-fan rotation and record fan and motor data including number of fans and entering- and leaving-air temperatures.

3.12 PROCEDURES FOR CONDENSING UNITS

- A. Verify proper rotation of fans.
- B. Measure entering- and leaving-air temperatures.
- C. Record compressor data.

3.13 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
- C. Measure outside-air, wet- and dry-bulb temperatures.

3.14 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 1. Measure and record the static pressure at the hood exhaust-duct connection.
 2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of **12 inches (300 mm)** between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.

- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
 - 1. Check duct slopes as required.
 - 2. Verify that duct access is installed as required.
 - 3. Verify that point of termination is as required.
 - 4. Verify that duct air velocity is within the range required.
 - 5. Verify that duct is within a fire-rated enclosure.
- D. Report deficiencies.

3.15 PROCEDURES FOR VIBRATION MEASUREMENTS

- A. Use a vibration meter meeting the following criteria:
 - 1. Solid-state circuitry with a piezoelectric accelerometer.
 - 2. Velocity range of 0.1 to 10 inches per second (2.5 to 254 mm/s).
 - 3. Displacement range of 1 to 100 mils (0.0254 to 2.54 mm).
 - 4. Frequency range of at least 0 to 1000 Hz.
 - 5. Capable of filtering unwanted frequencies.
- B. Calibrate the vibration meter before each day of testing.
 - 1. Use a calibrator provided with the vibration meter.
 - 2. Follow vibration meter and calibrator manufacturer's calibration procedures.
- C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
 - 1. Turn off equipment in the building that might interfere with testing.
 - 2. Clear the space of people.
- D. Perform vibration measurements after air and water balancing and equipment testing is complete.
- E. Clean equipment surfaces in contact with the vibration transducer.
- F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.
- G. Measure and record vibration on rotating equipment over 3 hp (2.2 kW).
- H. Measure and record equipment vibration, bearing vibration, equipment base vibration, and building structure vibration. Record velocity and displacement readings in the horizontal, vertical, and axial planes.
 - 1. Pumps:
 - a. Pump Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Pump Base: Top and side.
 - d. Building: Floor.
 - e. Piping: To and from the pump after flexible connections.
 - 2. Fans and HVAC Equipment with Fans:
 - a. Fan Bearing: Drive end and opposite end.

- b. Motor Bearing: Drive end and opposite end.
- c. Equipment Casing: Top and side.
- d. Equipment Base: Top and side.
- e. Building: Floor.
- f. Ductwork: To and from equipment after flexible connections.
- g. Piping: To and from equipment after flexible connections.
- 3. Chillers and HVAC Equipment with Compressors:
 - a. Compressor Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Equipment Casing: Top and side.
 - d. Equipment Base: Top and side.
 - e. Building: Floor.
 - f. Piping: To and from equipment after flexible connections.
- I. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.
- J. Inspect, measure, and record vibration isolation.
 - 1. Verify that vibration isolation is installed in the required locations.
 - 2. Verify that installation is level and plumb.
 - 3. Verify that isolators are properly anchored.
 - 4. For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.
 - 5. Measure the operating clearance between each inertia base and the floor or concrete base below. Verify that there is unobstructed clearance between the bottom of the inertia base and the floor.

3.16 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the 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.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.

- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.

3.17 SPACE PRESSURIZATION VERIFICATION

- A. Contractor shall verify differential pressure readings across 100% of exterior doors to ensure the building is not over pressurized or negative. Contractor shall provide the readings in the final test and balance report.
- B. Contractor shall note in the final test and balance report if there are any issues regarding doors unable to close due to pressurization issue.

3.18 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
 - 2. Air Outlets and Inlets: Plus or minus 10 percent.
 - 3. Heating-Water Flow Rate: Plus or minus 10 percent.
 - 4. Cooling-Water Flow Rate: Plus or minus 10 percent.

3.19 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: 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. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.20 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-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 instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
1. Pump curves.
 2. Fan curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB firm who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Data for terminal units, including manufacturer, type size, and fittings.
 14. Notes to explain why certain final data in the body of reports varies from indicated values.
 15. Test conditions for fans and pump performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Face and bypass damper settings at coils.
 - e. Fan drive settings including settings and percentage of maximum pitch diameter.
 - f. Inlet vane settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water and steam flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.

7. Position of balancing devices.
- F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in **inches (mm)**, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in **inches (mm)**.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
 2. Motor Data:
 - a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in **inches (mm)**, and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in **inches (mm)**.
 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in **cfm (L/s)**.
 - b. Total system static pressure in **inches wg (Pa)**.
 - c. Fan rpm.
 - d. Discharge static pressure in **inches wg (Pa)**.
 - e. Filter static-pressure differential in **inches wg (Pa)**.
 - f. Preheat coil static-pressure differential in **inches wg (Pa)**.
 - g. Cooling coil static-pressure differential in **inches wg (Pa)**.
 - h. Heating coil static-pressure differential in **inches wg (Pa)**.
 - i. Outside airflow in **cfm (L/s)**.
 - j. Return airflow in **cfm (L/s)**.
 - k. Outside-air damper position.
 - l. Return-air damper position.
 - m. Vortex damper position.
- G. Apparatus-Coil Test Reports:
1. Coil Data:
 - a. System identification.
 - b. Location.
 - c. Coil type.
 - d. Number of rows.
 - e. Fin spacing in **fins per inch (mm)** o.c.
 - f. Make and model number.
 - g. Face area in **sq. ft. (sq. m)**.
 - h. Tube size in **NPS (DN)**.
 - i. Tube and fin materials.
 - j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in **cfm** (L/s).
 - b. Average face velocity in **fpm** (m/s).
 - c. Air pressure drop in **inches wg** (Pa).
 - d. Outside-air, wet- and dry-bulb temperatures in **deg F** (deg C).
 - e. Return-air, wet- and dry-bulb temperatures in **deg F** (deg C).
 - f. Entering-air, wet- and dry-bulb temperatures in **deg F** (deg C).
 - g. Leaving-air, wet- and dry-bulb temperatures in **deg F** (deg C).
 - h. Water flow rate in **gpm** (L/s).
 - i. Water pressure differential in **feet of head** or **psig** (kPa).
 - j. Entering-water temperature in **deg F** (deg C).
 - k. Leaving-water temperature in **deg F** (deg C).
 - l. Refrigerant expansion valve and refrigerant types.
 - m. Refrigerant suction pressure in **psig** (kPa).
 - n. Refrigerant suction temperature in **deg F** (deg C).
 - o. Inlet steam pressure in **psig** (kPa).

- H. Electric-Coil Test Reports: For electric furnaces, duct coils, and electric coils installed in central-station air-handling units, include the following:
 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Coil identification.
 - d. Capacity in **Btuh** (kW).
 - e. Number of stages.
 - f. Connected volts, phase, and hertz.
 - g. Rated amperage.
 - h. Airflow rate in **cfm** (L/s).
 - i. Face area in **sq. ft.** (sq. m).
 - j. Minimum face velocity in **fpm** (m/s).
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in **Btuh** (kW).
 - b. Airflow rate in **cfm** (L/s).
 - c. Air velocity in **fpm** (m/s).
 - d. Entering-air temperature in **deg F** (deg C).
 - e. Leaving-air temperature in **deg F** (deg C).
 - f. Voltage at each connection.
 - g. Amperage for each phase.

- I. Fan Test Reports: For supply, return, and exhaust fans, include the following:
 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in **inches** (mm), and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in **inches** (mm).
 2. Motor Data:

- a. Make and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches (mm), and bore.
 - f. Sheave dimensions, center-to-center, and amount of adjustments in inches (mm).
 - g. Number of belts, make, and size.
- 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm (L/s).
 - b. Total system static pressure in inches wg (Pa).
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg (Pa).
 - e. Suction static pressure in inches wg (Pa).
- J. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
 - 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F (deg C).
 - d. Duct static pressure in inches wg (Pa).
 - e. Duct size in inches (mm).
 - f. Duct area in sq. ft. (sq. m).
 - g. Indicated airflow rate in cfm (L/s).
 - h. Indicated velocity in fpm (m/s).
 - i. Actual airflow rate in cfm (L/s).
 - j. Actual average velocity in fpm (m/s).
 - k. Barometric pressure in psig (Pa).
- K. Air-Terminal-Device Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft. (sq. m).
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm (L/s).
 - b. Air velocity in fpm (m/s).
 - c. Preliminary airflow rate as needed in cfm (L/s).
 - d. Preliminary velocity as needed in fpm (m/s).
 - e. Final airflow rate in cfm (L/s).
 - f. Final velocity in fpm (m/s).
 - g. Space temperature in deg F (deg C).
- L. Packaged Chiller Reports: