

SECTION 096519 - RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 THIS SECTION INCLUDES

- A. Flooring and accessories as shown on the drawings and schedules and as indicated by the requirements of this section.

1.2 RELATED DOCUMENTS

- A. Drawings and General Provisions of the Contract (including General and Supplementary Conditions and Division 1 sections) apply to the work of this section.

1.3 RELATED SECTIONS

- A. Other Division 9 sections for floor finishes related to this section but not the work of this section.
- B. Division 3 Concrete; not the work of this section.
- C. Division 6 Wood and Plastics; not the work of this section.
- D. Division 7 Thermal and Moisture Protection; not the work of this section.

1.4 QUALITY ASSURANCE AND REGULATORY REQUIREMENTS

- A. Select an installer who is competent in the installation of Armstrong resilient tile flooring.
- B. If required, provide types of flooring and accessories supplied by one manufacturer, including leveling and patching compounds, and adhesives.
- C. If required, provide flooring material to meet the following fire test performance criteria as tested by a recognized independent testing laboratory:
  - a. ASTM E 648 Critical Radiant Flux of 0.45 watts per sq. cm. or greater, Class I.
  - b. ASTM E 662 (Smoke Generation) Maximum Specific Optical Density of 450 or less.

1.5 SUBMITTALS

- A. Submit shop drawings, seaming plan, coving details, and manufacturer's technical data, installation and maintenance instructions (latest edition of "Armstrong Guaranteed Installation System," F-5061) for flooring and accessories.

- B. Submit the manufacturer's standard samples showing the required colors for flooring and applicable accessories.
- C. If required, submit the manufacturer's certification that the flooring has been tested by an independent laboratory and complies with the required fire tests.

#### 1.6 ENVIRONMENTAL CONDITIONS

- A. Deliver materials in good condition to the jobsite in the manufacturer's original unopened containers that bear the name and brand of the manufacturer, project identification, and shipping and handling instructions.
- B. Store materials in a clean, dry, enclosed space off the ground, and protected from the weather and from extremes of heat and cold. Protect adhesives from freezing. Store flooring, adhesives and accessories in the spaces where they will be installed for at least 48 hours before beginning installation.
- C. Maintain a minimum temperature in the spaces to receive the flooring and accessories of 65°F (18°C) and a maximum temperature of 100°F (38°C) for at least 48 hours before, during, and for not less than 48 hours after installation. Thereafter, maintain a minimum temperature of 55°F (13°C) in areas where work is completed. Protect all materials from the direct flow of heat from hot-air registers, radiators, or other heating fixtures and appliances.
- D. Install flooring and accessories after the other finishing operations, including painting, have been completed. Close spaces to traffic during the installation of the flooring. Do not install flooring over concrete slabs until they are sufficiently dry to achieve a bond with the adhesive, in accordance with the manufacturer's recommended bond and moisture tests.

### PART 2 PRODUCTS

#### 2.1 RESILIENT TILE FLOORING MATERIALS

- A. Provide Imperial® Texture Standard EXCELON® Tile Flooring manufactured by Armstrong World Industries, Inc., in color selected from the range currently available from Armstrong World Industries, Inc., having a nominal total thickness of 1/8" / 0.125 in. (3.2 mm), 12 in. x 12 in. (305 mm x 305 mm), composed of polyvinyl chloride resin binder, plasticizers, fillers, and pigments with colors and texture dispersed uniformly throughout its thickness. Vinyl composition tile shall conform to the requirements of ASTM F 1066, Class 2 – through pattern.

#### 2.2 WALL BASE MATERIALS

- A. Provide 0.080 in. (2.0 mm) thick, 4 in. (10.16 cm) high Armstrong Color-Integrated Wall Base

with a matte finish, conforming to ASTM F 1861, Type TP - Rubber, Thermoplastic, Group 1  
- Solid, Style B - Cove. Color as selected from Full Range of Manufacturers colors.

### 2.3 ADHESIVES

- A. For Tile Installation System, Full Spread: Provide Armstrong S-515 Resilient Tile Adhesive under the tile and Armstrong S-725 Wall Base Adhesive at the wall base as recommended by the flooring manufacturer.

### 2.4 ACCESSORIES

- A. For patching, smoothing, and leveling monolithic subfloors (concrete, terrazzo, quarry tile, ceramic tile, and certain metals), provide Armstrong S-183 Fast-Setting Cement-Based Underlayment.
- B. For sealing joints between the top of wall base or integral cove cap and irregular wall surfaces such as masonry, provide plastic filler applied according to the manufacturer's recommendations.
- C. Provide transition/reducing strips tapered to meet abutting materials.
  - 1. Provide threshold of thickness and width as shown on the drawings.
  - 2. Provide resilient edge strips of width shown on the drawings, of equal gauge to the flooring, homogeneous vinyl or rubber composition, tapered or bullnose edge, with color to match or contrast with the flooring, or as selected by the Architect from standard colors available.
  - 3. Provide metal edge strips of width shown on the drawings and of required thickness to protect exposed edges of the flooring. Provide units of maximum available length to minimize the number of joints. Use butt-type metal edge strips for concealed anchorage, or overlap-type metal edge strips for exposed anchorage. Unless otherwise shown, provide strips made of extruded aluminum with a mill finish.

### 2.5 ALTERNATE MANUFACTURERS

- D. Products: Subject to compliance with requirements, available equal product manufacturers that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Congoleum Corporation
  - 2. Burke
  - 3. Tarkett, Inc.

## PART 3 EXECUTION

### 3.1 INSPECTION

- A. Examine subfloors prior to installation to determine that surfaces are smooth and free from cracks, holes, ridges, and other defects that might prevent adhesive bond or impair durability or appearance of the flooring material.
- B. Inspect subfloors prior to installation to determine that surfaces are free from curing, sealing, parting and hardening compounds; residual adhesives; adhesive removers; and other foreign materials that might prevent adhesive bond. Visually inspect for evidence of moisture, alkaline salts, carbonation, dusting, mold, or mildew.
- C. Report conditions contrary to contract requirements that would prevent a proper installation. Do not proceed with the installation until unsatisfactory conditions have been corrected.
- D. Failure to call attention to defects or imperfections will be construed as acceptance and approval of the subfloor. Installation indicates acceptance of substrates with regard to conditions existing at the time of installation.

### 3.2 PREPARATION

- A. Smooth concrete surfaces, removing rough areas, projections, ridges, and bumps, and filling low spots, control or construction joints, and other defects with Armstrong S-183 Fast-Setting Cement-Based Underlayment as recommended by the flooring manufacturer.
- B. Remove paint, varnish, oils, release agents, sealers, and waxes. Remove residual adhesives as recommended by the flooring manufacturer. Remove curing and hardening compounds not compatible with the adhesives used, as indicated by a bond test or by the compound manufacturer's recommendations for flooring. Avoid organic solvents.
- C. [For Tile Installation System, Full Spread or for Tile Installation System, Tile On , perform subfloor moisture testing in accordance with [ASTM F 2170, "Standard Test Method for Determining Relative Humidity in Concrete Slabs Using *in-situ* Probes"] ASTM F 1869, "Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride" and Bond Tests as described in publication F-5061, "Armstrong Guaranteed Installation System," to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Relative humidity shall not exceed 80%. MVER shall not exceed 5 lbs./1000 sq. ft./24 hrs. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.]
- D. Perform pH tests on concrete floors regardless of their age or grade level. All test results shall be documented and retained
- E. Vacuum or broom-clean surfaces to be covered immediately before the application of flooring. Make subfloor free from dust, dirt, grease, and all foreign materials.

### 3.3 INSTALLATION OF TILE FLOORING

- A. Install flooring in strict accordance with the latest edition of "Armstrong Guaranteed

Installation System", F-5061.

- B. Install flooring wall to wall before the installation of floor-set cabinets, casework, furniture, equipment, movable partitions, etc. Extend flooring into toe spaces, door recesses, closets, and similar openings as shown on the drawings.
- C. If required, install flooring on pan-type floor access covers. Maintain continuity of color and pattern within pieces of flooring installed on these covers. Adhere flooring to the subfloor around covers and to covers.
- D. Scribe, cut, and fit to permanent fixtures, columns, walls, partitions, pipes, outlets, and built-in furniture and cabinets.
- E. Install flooring with adhesives, tools, and procedures in strict accordance with the manufacturer's written instructions. Observe the recommended adhesive trowel notching, open times, and working times.

#### 3.4 INSTALLATION OF ACCESSORIES

- A. Apply top set wall base to walls, columns, casework, and other permanent fixtures in areas where top-set base is required. Install base in lengths as long as practical, with inside corners fabricated from base materials that are mitered or coped. Tightly bond base to vertical substrate with continuous contact at horizontal and vertical surfaces.
- B. Fill voids with plastic filler along the top edge of the resilient wall base or integral cove cap on masonry surfaces or other similar irregular substrates.
- C. Place resilient edge strips tightly butted to flooring, and secure with adhesive recommended by the edge strip manufacturer. Install edge strips at edges of flooring that would otherwise be exposed.
- D. Apply [butt-type] [overlap] metal edge strips where shown on the drawings, [before] [after] flooring installation. Secure units to the substrate, complying with the edge strip manufacturer's recommendations.

#### 3.5 CLEANING AND PROTECTION

- A. Perform initial maintenance according to the latest edition of "Armstrong Guaranteed Installation System," F-5061.
- B. Protect installed flooring as recommended by the flooring manufacturer against damage from rolling loads, other trades, or the placement of fixtures and furnishings. (See Finishing The Job in "Armstrong Guaranteed Installation System," F-5061.)

END OF SECTION 096519

SECTION 096816 – SHEET CARPETING

1.0 GENERAL – BROADLOOM CARPET

1.1 SECTION INCLUDES

- A. Broadloom carpet, direct glued to substrate.
- B. Accessories.

1.2 REFERENCES

- A. American Association of Text broadloom Chemists and Colorists (AATCC):
  - 1. AATCC 16-[98], Test Method for Colorfastness to Light.
  - 2. AATCC 23-[99], Test Method for Colorfastness to Burnt Gas Fumes.
  - 3. AATCC 107-[97], Test Method for Colorfastness to Water.
  - 4. AATCC 109-[97], Test Method for Colorfastness to Ozone in the Atmosphere Under Low Humidities.
  - 5. AATCC 117-[99], Test Method for Colorfastness to Heat: Dry (Excluding Pressing).
  - 6. AATCC 134-[96], Test Method for Electrostatic Propensity of Carpets.
  - 7. AATCC 165-[93], Test Method for Colorfastness to Crocking: Carpets - AATCC Crockmeter Method.
  - 8. AATCC 174-[98], Test Method for Antimicrobial Activity Assessment of Carpets.
  - 9. AATCC 175-[98], Test Method for Stain Resistance: Pile Floor Coverings.
- B. American Society for Testing and Materials (ASTM):
  - 1. ASTM D418 Methods of Testing Pile Yarn Floor Covering Construction.

2. ASTM D5116, Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products.
  3. ASTM E648-. Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
  4. ASTM E662-, Test Method for Specific Optical Density of Smoke Generated by Solid Materials.
- C. Carpet & Rug Institute (CRI):
1. CRI Indoor Air Quality Testing and Labeling Program.
- D. U.S. Department of Housing and Urban Development (HUD):
1. HUD UM44D-[93], HUD Building Product Standards and Certification Program for Carpet.

### 1.3 PERFORMANCE REQUIREMENTS

A. Comply with the following Performance Requirements:

1. Carpet Flammability
  - a. Methanamine Pill Test (DOC FF-1-70): Passes
  - b. Floor Radiant Panel (ASTM E-648): Class 1
  - c. Smoke Density (ASTM E-662): Less Than 450
2. Wearability: Ten year commercial Limited Warranty for Classicbac Products.
3. Colorfastness Warranties: Lifetime Colorfastness to Light, Lifetime Colorfastness to Atmospheric Contaminants
6. Backing Integrity/Delamination: Ten year Limited Warranty.
7. Traffic Class: Moderate/Heavy
8. CRI Green Label: [GLP6878]
9. ADA Compliance: This Product Meets the Guidelines as Set Forth in the Americans with Disabilities Act for Minimum Static Coefficient of Friction of 0.6 for Accessible Routes.

### 1.4 SUBMITTALS

- A. Manufacturer's Data  
Submit two (2) copies of manufacturer's specifications and

installation instructions for carpet and related items specified.

- B. **Fiber Verification**  
Submit certification from the fiber producer verifying use of the branded fiber in the submitted carpet product.
- C. **Shop Drawings**  
For carpeted areas submit shop drawings showing installation of carpeting, seam diagram, pattern direction, necessary installation accessories, and provisions for work of other trades. Show location of different patterns or styles of carpet. Also, show locations of any threshold conditions.
1. The contractor will supply reproducible prints on request, to facilitate shop drawing preparation.
- D. **Samples**  
Submit standard-size carpet samples of each type of carpet, in each specified pattern, color, and construction.
1. Any alternates to specified products must be submitted for approval by a representative of the end user or architect/design firm at least ten (10) working days prior to bid or proposal.
  2. **Final Sample Submittal**  
Submit two (2) sets of samples for each carpet type.
  3. No carpet shipments are permitted until acceptance of final samples is given by representative of the end user or architect/design firm, certifying that samples are the approved color, pattern, and texture.
  4. Samples submitted are assumed to the manufacturer's best obtainable match to the carpet described under Materials Section.

#### 1.5 CLOSEOUT SUBMITTALS

- A. **Maintenance Data:** Include maintenance procedures, recommended cleaning and stain-removal materials, and recommended cleaning schedule. Include product data and Material Safety Data Sheets (MSDS) for cleaning and stain-removal materials.



1.6 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products from a single manufacturer for each recyclable carpet type specified.
- B. Sustainability Commitment: Carpet manufacturer must practice environmental responsibility through programs of raw material reduction, recycling, reuse, and energy and natural resource conservation.

1.7 QUALIFICATIONS

- B. Installer: Company specializing in installing carpet [with minimum {five (5)} years {documented} Experience in installation.

1.8 PRE-INSTALLATION MEETINGS

- A. Convene one (1) week prior to commencing work of this section.
- B. Require attendance of installer, contractor, owner, architect and other parties directly affecting the work of this section.
- C. Review carpet [recycling procedures outlined in manufacturer's environmental program and] installation procedures and coordination with work of other sections.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Deliver carpet in sealed protective rolls and accessories in sealed containers. Bind carpet materials with secure protective wrapping. Mark each carpet roll according to style, color, pattern, dye lot, run number, and quantity.
- B. Store products in an enclosed and dry area protected from damage and soiling.

1.10 ENVIRONMENTAL REQUIREMENTS

- A. Do not install carpet until areas have been fully enclosed and environmental conditions have reached the levels indicated during occupancy.
- B. Maintain ambient temperature and humidity conditions during and after installation of broadloom carpet at levels indicated during occupancy.

- C. Allow carpet to reach room temperature or minimum temperature recommended by manufacturer before beginning installation.
- 1.11 FIELD MEASUREMENTS
- A. Verify that field measurements are as indicated on Drawings.
- 1.12 SEQUENCING
- A. Sequence installation so as to minimize possibility of damage and soiling of carpet.
  - B. Do not commence installation until painting and finishing work are complete, and ceiling and overhead work have been tested, approved, and completed.
- 1.13 WARRANTY
- A. Provide carpet manufacturer's [10] year warranty against defects in materials.
  - B. Warranty: Include coverage for:
    - 1. Surface Wear: Not more than 10 percent by weight throughout life of product.
    - 2. Static: Maintain static generation at less than 3.5 kV at 70 degrees F, and 20 percent R.H. throughout life of product.
    - 3. No delamination throughout life of product.
    - 4. No edge ravel throughout life of product.
    - 5. Provide tuft bind consistent with industry standards.
    - 6. For High Performance broadloom: Ten year commercial. Warranty that owner will be completely satisfied with performance of carpet when installed in accordance with manufacturer's installation instructions and when maintained in accordance with current carpet care recommendations, and when such maintenance continues throughout duration of warranty period when owned and operated by original Owner
    - 7. Provide carpet installer's [one (1)]year warranty against defects in installation.

1.14 EXTRA MATERIALS

- A. Provide [three (3)] percent overage of calculated yardage for each type of carpet (include carpet needed for complete installation plus waste and usable scraps in calculated yardage).
- B. Deliver specified overrun and usable pieces of carpet to owner's designated storage space, properly packaged and identified. Redirect small pieces of waste carpet to be appropriately recycled.

2.0 PRODUCTS

2.1 MANUFACTURERS

- A. Shaw Industries, Inc.  
P.O. Drawer 2128  
Dalton, Georgia 30722-2128
- B. Substitutions: Subject to compliance with the following requirements:

2.2 CARPET CONSTRUCTION

- A. All yarn and carpet shall be manufacturer's first quality and 100% recyclable downcycable. No carpet should end its useful life in a landfill.
- B. For optimum performance, carpet density will be a minimum of 5,000 oz./cubic yard.

2.3 PRODUCT SPECIFICATIONS

- A. Product: Standing Ovation – J0040
- B. Construction Type: Graphic Loop
- C. Face Fiber: 88% Anso FX SD BCF Nylon – 12% Yarn Dyed BCF Nylon
- D. Gauge: 1/10"
- E. Stitches: 11 per inch
- F. Density: 6455 ozs/yd<sup>3</sup>

G. Yarn Weight: 26 ozs/yd<sup>2</sup>

H. Pile Thickness (ASIM D-418) 0.145"

I. Backing Structure: Classicbac

J. Width 12'

K. Base Color Method: 88% Solution Dyed / 12% Yarn dyed

## 2.4 ACCESSORIES

- A. Leveling Compound: Latex type as recommended by carpet manufacturer; compatible with carpet adhesive and curing/sealing compound used on concrete.
- B. Multi-Purpose Adhesive: Low VOC permanent carpet adhesive as recommended by carpet manufacturer for direct glue down of carpet; comply with CRI Green Label Certification Program. Use slow-set permanent adhesive for patterned carpet to facilitate pattern match.
- C. Non-Metallic Carpet Edge Guard: Extruded or molded heavy-duty vinyl or rubber carpet edge guard of size and profile indicated; minimum two (2) inch wide anchorage flange; colors selected by Architect from manufacturer's standard range of colors.
- D. Miscellaneous Materials: As recommended by manufacturer of carpet, cushion, and other carpeting products; as required to complete installation.

## 3.0 EXECUTION

### 3.1 EXAMINATION

- A. Exam substrates for conditions under which carpeting is to be installed.
- B. Verify that floor surfaces are smooth and flat within [tolerances and are ready to receive work.
- C. Beginning of installation means installer accepts existing substrate conditions.

### 3.2 PREPARATION

- A. Allow new concrete to cure for 90 days before carpet installation starts.
- B. Perform moisture content testing as required by manufacturer's instructions to ensure pH readings of no more than nine (9). Moisture transmission of 5.5 lbs/sq ft per 24 hours is acceptable. If values exceed this level, follow manufacturer's recommendations for moisture transmission mitigation. Do not proceed until unsatisfactory conditions have been corrected.
- C. Remove sub-floor ridges and bumps. Fill minor or local low spots, cracks, joints, holes, and other defects with sub-floor filler.
- D. Fill, level, and make smooth cracks 1/16 inch or more, holes, unevenness, and roughness with compatible latex floor patching compound. Feather floor filling or leveling compound a minimum of four (4) ft. Sweep floor of loose granular debris prior to filling. After filling, allow filler to dry. Damp mop floor with warm water and allow to dry. Vacuum after mopping to ensure that loose granular debris is removed and to provide a proper substrate to install broadloom carpet. Prohibit traffic until filler is cured.
- E. Vacuum floors again immediately before installation of carpeting.
- F. Confirm compatibility of adhesive with curing compounds on concrete floors.
- G. Preheat areas to receive carpet to a minimum temperature of 68 degrees F for 72 hours prior to installation, with a relative humidity of not more than 65 percent. Maintain minimum temperature of 50 degrees F thereafter. Carpet and adhesive must be stored at a minimum temperature of 68 degrees F for 72 hours prior to installation.

### 3.3 INSTALLATION

- A. Install carpet in accordance with manufacturer's instructions and CRI Carpet Installation Standard.
- B. Install carpet under open-bottom obstructions and under removable flanges and furnishings, and into alcoves and closets in each space.

- C. Provide cutouts where required. Conceal cut edges with protective edge guards or flanges.
- D. Run carpet under open-bottom items and install tight against walls, columns, and cabinets so that the entire floor area is covered with carpet. Cover over floor-type door closers.
- E. Install edging guard at openings and doors wherever carpet terminates, unless indicated otherwise.
- F. Perform cutting in accordance with manufacturers recommendation using tools designed for carpet being installed. Verify carpet match before cutting to ensure minimal variation between dye lots. Retain or dispose of scraps in accordance with manufacturer's environmental program.
- G. Removal of carpet to be replaced (if applicable) should be handled according to pre-approved plan for recycling.
- H. Install carpet from same dye lot and run within each continuous carpet area.
- I. Seal seams with manufacturer recommended seam sealer, if applicable.
- J. Install carpet with pile-lay in same direction except when indicated otherwise on drawings.
- K. Use leveling compound where necessary. Feather floor leveling compound minimum of 4 ft.
- L. Do not bridge building expansion joints with continuous carpeting. Provide for movement.
- M. Apply environmentally approved adhesive in accordance with manufacturer's instructions in area to be carpeted first.
- N. Apply seam adhesive to base of edge glued down. Lay adjoining piece with seam straight, not overlapped or peaked, and free of gaps.
- O. Roll with appropriate roller for complete contact of adhesive to carpet backing.
- P. Trim carpet neatly at walls and around interruptions.
- Q. Extend carpet as base finish up vertical surface to form base. Terminate top of base with cap strip.

- R. Complete installation of edge strips, concealing exposed edges.
- S. Cut carpet at fixtures, architectural elements, and perimeters.
- T. Use a fixed reducer strip to secure broadloom area in open perimeter designs.
- U. Install carpet on stairs using an environmentally acceptable permanent adhesive. Furnish and install compatible edge trim and nosing products as required.

#### 3.4 FIELD QUALITY CONTROL

- A. Inspect completed carpet installation on each floor.
- B. Verify that installation is complete; work is properly done and acceptable.
- C. Remove and replace, at no additional cost to owner, any work found not to be acceptable.

#### 3.5 CLEANING

- A. On completion of installation in each area, remove dirt and carpet scraps from surface of carpet. Remove soiling, spots, or excess adhesive on carpet with cleaning materials recommended by carpet manufacturer.
- B. Remove debris; sort pieces from carpet scraps to redirected and recycled.
- C. At completion of work, vacuum carpet using commercial vacuuming equipment as recommended by carpet manufacturer. Remove spots and replace carpet where spots cannot be removed. Remove rejected carpeting and replace with new carpeting. Remove any protruding yarns with shears or sharp scissors.

#### 3.6 PROTECTION

- A. Do not permit traffic over unprotected floor surface.
- B. Protect carpet against damage during construction. Cover with 6-mil thick polyethylene covering with taped joints during construction period whenever protection is required, so that carpet will be without any indication of deterioration, wear, or damage at time of completion.

- C. Damaged carpet will be rejected and recycled. As carpet is installed, remove trimmings, excess pieces of carpet, and installation materials.
- D. Maintain protection of carpeting on each floor or area until work is accepted.

END OF SECTION 096816



SECTION 099113 - 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. This Section includes surface preparation and the application of paint systems on the following exterior substrates:
  - 1. Concrete.
  - 2. Steel.
  - 3. Galvanized metal.
  - 4. Aluminum (not anodized or otherwise coated).
- B. Related Sections include the following:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.
  - 2. Division 08 Sections for factory priming windows and doors with primers specified in this Section.
  - 3. Division 09 Section "Interior Painting" for surface preparation and the application of paint systems on interior substrates.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and each color and gloss of topcoat indicated.
  - 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.
- D. 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.

#### 1.4 QUALITY ASSURANCE

##### A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

##### B. Mockups: Apply benchmark samples 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 benchmark samples.
  - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.5 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.

#### 1.6 PROJECT 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.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Benjamin Moore & Co.
  2. Benjamin Moore & Co., Limited (Canada).
  3. Bennette Paint Mfg. Co., Inc.
  4. BLP Mobile Paint Manufacturing.
  5. California Paints.
  6. ChemRex.
  7. Cloverdale Paint.
  8. Color Wheel Paints & Coatings.
  9. Columbia Paint & Coatings.
  10. Coronado Paint.
  11. Davis Paint Company.
  12. Del Technical Coatings.
  13. Diamond Vogel Paints.
  14. Dunn-Edwards Corporation.
  15. Durant Paints Inc.
  16. Duron, Inc.
  17. Envirocoat Technologies Inc.
  18. Farrell-Calhoun.
  19. Flex Bon Paints.
  20. Frazee Paint.
  21. General Paint.
  22. Griggs Paint.
  23. Hallman Lindsay Quality Paints.
  24. Hirshfield's, Inc.
  25. ICI Devoe (Canada).
  26. ICI Paints.
  27. ICI Paints (Canada).

28. Insl-x.
29. Iowa Paint Manufacturing Company, Inc.
30. Kelly-Moore Paints.
31. Kryton Canada Corporation.
32. Kwal-Howells Paint.
33. M.A.B. Paints.
34. McCormick Paints.
35. Miller Paint.
36. Mills Paint.
37. NCP Coatings.
38. Northern Paint.
39. PARA Paints.
40. Parker Paint Mfg. Co. Inc.
41. Porter Paints.
42. PPG Architectural Finishes, Inc.
43. Rodda Paint Co.
44. Sherwin-Williams Company (The).
45. Sico, Inc.
46. Sigma Coatings.
47. Smiland Paint Company.
48. Spectra-Tone.
49. Tamms Industries, Inc.
50. Tower Paint.
51. Vista Paint.

## 2.2 PAINT, GENERAL

### A. 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.

### B. Colors: As selected by Architect from manufacturer's full range and as indicated in a color schedule.

## 2.3 BLOCK FILLERS

### A. Interior/Exterior Latex Block Filler: MPI #4.

1. VOC Content: E Range of E2.

#### 2.4 PRIMERS/SEALERS

- A. Alkali-Resistant Primer: MPI #3.
  - 1. VOC Content: E Range of E1.
- B. Bonding Primer (Water Based): MPI #17.
  - 1. VOC Content: E Range of E1.
- C. Bonding Primer (Solvent Based): MPI #69.
  - 1. VOC Content: E Range of E1.
- D. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint system indicated.

#### 2.5 METAL PRIMERS

- A. Alkyd Anticorrosive Metal Primer: MPI #79.
  - 1. VOC Content: E Range of E1.
- B. Quick-Drying Alkyd Metal Primer: MPI #76.
  - 1. VOC Content: E Range of E1.
- C. Waterborne Galvanized-Metal Primer: MPI #134.
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 1.
- D. Quick-Drying Primer for Aluminum: MPI #95.
  - 1. VOC Content: E Range of E1.

#### 2.6 EXTERIOR LATEX PAINTS

- A. Exterior Latex (Flat): MPI #10 (Gloss Level 1).
  - 1. VOC Content: E Range of E1.
- B. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).
  - 1. VOC Content: E Range of E1.
- C. Exterior Latex (Gloss): MPI #119 (Gloss Level 6, except minimum gloss of 65 units at 60 deg).

1. VOC Content: E Range of E1.

## 2.7 EXTERIOR ALKYD PAINTS

- A. Exterior Alkyd Enamel (Flat): MPI #8 (Gloss Level 1).

1. VOC Content: E Range of E1.

- B. Exterior Alkyd Enamel (Semigloss): MPI #94 (Gloss Level 5).

1. VOC Content: E Range of E1.

- C. Exterior Alkyd Enamel (Gloss): MPI #9 (Gloss Level 6).

1. VOC Content: E Range of E1.

## 2.8 QUICK-DRYING ENAMELS

- A. Quick-Drying Enamel (Semigloss): MPI #81 (Gloss Level 5).

1. VOC Content: E Range of E1.

- B. Quick-Drying Enamel (High Gloss): MPI #96 (Gloss Level 7).

1. VOC Content: E Range of E1.

## 2.9 ALUMINUM PAINT

- A. Aluminum Paint: MPI #1.

1. VOC Content: E Range of E1.

## 2.10 FLOOR COATINGS

- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.

1. VOC Content: E Range of E1.

- B. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.

1. VOC Content: E Range of E1.

### 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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Plaster: 12 percent.
  - 5. Gypsum Board: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers 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. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- F. 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.
- G. Aluminum Substrates: Remove surface oxidation.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  - 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.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

### 3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
  - 1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  - 2. Testing agency will perform tests for compliance of paint materials with product requirements.
  - 3. 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.

### 3.5 CLEANING AND PROTECTION

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

### 3.6 EXTERIOR PAINTING SCHEDULE – SEE PLANS FOR SURFACES

- A. Concrete Substrates, Nontraffic Surfaces:
  - 1. High-Build Latex System: MPI EXT 3.1L, applied to form dry film thickness of not less than 10 mils (0.25 mm).
    - a. Prime Coat: As recommended in writing by topcoat manufacturer.
    - b. Intermediate Coat: As recommended in writing by topcoat manufacturer.
    - c. Topcoat: High-build latex (exterior).
- B. Concrete Substrates, Traffic Surfaces:
  - 1. Clear Sealer System: MPI EXT 3.2G.
    - a. Prime Coat: Interior/exterior clear concrete floor sealer (solvent based).
    - b. Intermediate Coat: Interior/exterior clear concrete floor sealer (solvent based).
    - c. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).
  - 2. Water-Based Clear Sealer System: MPI EXT 3.2H.
    - a. Prime Coat: Interior/exterior clear concrete floor sealer (water based).
    - b. Intermediate Coat: Interior/exterior clear concrete floor sealer (water based).
    - c. Topcoat: Interior/exterior clear concrete floor sealer (water based).
- C. Steel Substrates:

1. Alkyd System: MPI EXT 5.1D.
  - a. Prime Coat: Alkyd anticorrosive metal primer.
  - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
  - c. Topcoat: Exterior alkyd enamel (semigloss).
  
- D. Galvanized-Metal Substrates:
  1. Latex Over Water-Based Primer System: MPI EXT 5.3H.
    - a. Prime Coat: Waterborne galvanized-metal primer.
    - b. Intermediate Coat: Exterior latex matching topcoat.
    - c. Topcoat: Exterior latex (semigloss).
  
  2. Alkyd System: MPI EXT 5.3B.
    - a. Prime Coat: Cementitious galvanized-metal primer.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel (semigloss).
  
- E. Aluminum Substrates:
  1. Latex System: MPI EXT 5.4H.
    - a. Prime Coat: Quick-drying primer for aluminum.
    - b. Intermediate Coat: Exterior latex matching topcoat.
    - c. Topcoat: Exterior latex semigloss
  
  2. Alkyd System: MPI EXT 5.4F.
    - a. Prime Coat: Quick-drying primer for aluminum.
    - b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
    - c. Topcoat: Exterior alkyd enamel semigloss.

END OF SECTION 099113

SECTION 099123 - 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. This Section includes surface preparation and the application of paint systems on the following interior substrates:
  - 1. Steel.
  - 2. Galvanized metal.
  - 3. Aluminum (not anodized or otherwise coated).
  - 4. Gypsum board.
- B. Related Sections include the following:
  - 1. Division 05 Sections for shop priming of metal substrates with primers specified in this Section.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Initial Selection: For each type of topcoat product indicated.
- C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat indicated.
  - 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.
- D. 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.

#### 1.4 QUALITY ASSURANCE

##### A. MPI Standards:

1. **Products:** Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. **Preparation and Workmanship:** Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

##### B. Mockups: Apply benchmark samples 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. **Wall and Ceiling Surfaces:** Provide samples of at least 100 sq. ft. (9 sq. m).
  - b. **Other Items:** Architect will designate items or areas required.
2. Apply benchmark samples after permanent lighting and other environmental services have been activated.
3. Final approval of color selections will be based on benchmark samples.
  - a. If preliminary color selections are not approved, apply additional benchmark samples of additional colors selected by Architect at no added cost to Owner.

#### 1.5 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.

#### 1.6 PROJECT 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.

## 1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.
  - 1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. (3.8 L) of each material and color applied.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Benjamin Moore & Co.
  - 2. Dunn-Edwards Corporation.
  - 3. Frazee Paint.
  - 4. ICI Paints.
  - 5. Sherwin-Williams Company (The).
  - 6. Vista Paint.

### 2.2 PAINT, GENERAL

- A. 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.
- B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
  - 1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
  - 2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
  - 3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  - 4. Floor Coatings: VOC not more than 100 g/L.

5. Shellacs, Clear: VOC not more than 730 g/L.
  6. Shellacs, Pigmented: VOC not more than 550 g/L.
  7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
  8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
  9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
  10. Floor Coatings: VOC not more than 100 g/L.
  11. Shellacs, Clear: VOC not more than 730 g/L.
  12. Shellacs, Pigmented: VOC not more than 550 g/L.
  13. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
  14. Dry-Fog Coatings: VOC content of not more than 400 g/L.
  15. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
  16. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.
- C. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:
1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
  2. Restricted Components: Paints and coatings shall not contain any of the following:
    - a. Acrolein.
    - b. Acrylonitrile.
    - c. Antimony.
    - d. Benzene.
    - e. Butyl benzyl phthalate.
    - f. Cadmium.
    - g. Di (2-ethylhexyl) phthalate.
    - h. Di-n-butyl phthalate.
    - i. Di-n-octyl phthalate.
    - j. 1,2-dichlorobenzene.
    - k. Diethyl phthalate.
    - l. Dimethyl phthalate.
    - m. Ethylbenzene.
    - n. Formaldehyde.
    - o. Hexavalent chromium.
    - p. Isophorone.
    - q. Lead.
    - r. Mercury.
    - s. Methyl ethyl ketone.
    - t. Methyl isobutyl ketone.
    - u. Methylene chloride.
    - v. Naphthalene.
    - w. Toluene (methylbenzene).
    - x. 1,1,1-trichloroethane.
    - y. Vinyl chloride.

- D. Colors: As selected by Architect from manufacturer's full range and as indicated in a color schedule.

### 2.3 BLOCK FILLERS

- A. Interior/Exterior Latex Block Filler: MPI #4.
  - 1. VOC Content: E Range of E2.

### 2.4 PRIMERS/SEALERS

- A. Interior Latex Primer/Sealer: MPI #50.
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 1.
- B. Interior Alkyd Primer/Sealer: MPI #45.
  - 1. VOC Content: E Range of E1.
- C. Wood-Knot Sealer: Sealer recommended in writing by topcoat manufacturer for use in paint systems indicated.

### 2.5 METAL PRIMERS

- A. Alkyd Anticorrosive Metal Primer: MPI #79.
  - 1. VOC Content: E Range of E1.
- B. Quick-Drying Alkyd Metal Primer: MPI #76.
  - 1. VOC Content: E Range of E1.
- C. Rust-Inhibitive Primer (Water Based): MPI #107.
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 1.
- D. Cementitious Galvanized-Metal Primer: MPI #26.
  - 1. VOC Content: E Range of E1.
- E. Waterborne Galvanized-Metal Primer: MPI #134.
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 1.

- F. Vinyl Wash Primer: MPI #80.
  - 1. VOC Content: E Range of E2.
- G. Quick-Drying Primer for Aluminum: MPI #95.
  - 1. VOC Content: E Range of E1.

## 2.6 WOOD PRIMERS

- A. Interior Latex-Based Wood Primer: MPI #39.
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 1.

## 2.7 LATEX PAINTS

- A. High-Performance Architectural Latex (Semigloss): MPI #141 (Gloss Level 5).
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 5.
- B. Exterior Latex (Semigloss): MPI #11 (Gloss Level 5).
  - 1. VOC Content: E Range of E1.

## 2.8 ALKYD PAINTS

- A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).
  - 1. VOC Content: E Range of E1.
  - 2. Environmental Performance Rating: EPR 1.

## 2.9 FLOOR COATINGS

- A. Interior/Exterior Clear Concrete Floor Sealer (Water Based): MPI #99.
  - 1. VOC Content: E Range of E1.
- B. Interior/Exterior Clear Concrete Floor Sealer (Solvent Based): MPI #104.
  - 1. VOC Content: E Range of E1.



### 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 work.
- B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
  - 1. Concrete: 12 percent.
  - 2. Masonry (Clay and CMU): 12 percent.
  - 3. Wood: 15 percent.
  - 4. Gypsum Board: 12 percent.
  - 5. Plaster: 12 percent.
- C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.
- D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
  - 1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

#### 3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.
- B. Remove plates, machined surfaces, and similar items already in place that 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.
  - 2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
- C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.
  - 1. Remove incompatible primers and reprime substrate with compatible primers 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. **Steel Substrates:** Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.
- F. **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.
- G. **Aluminum Substrates:** Remove surface oxidation.
- H. **Wood Substrates:**
  - 1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
  - 2. Sand surfaces that will be exposed to view, and dust off.
  - 3. Prime edges, ends, faces, undersides, and backsides of wood.
  - 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- I. **Gypsum Board Substrates:** Do not begin paint application until finishing compound is dry and sanded smooth.
- J. **Plaster Substrates:** Do not begin paint application until plaster is fully cured and dry.

### 3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions.
  - 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.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

- E. Painting Mechanical and Electrical Work: Paint items exposed in equipment rooms and occupied spaces including, but not limited to, the following:
1. Mechanical Work:
    - a. Uninsulated metal piping.
    - b. Uninsulated plastic piping.
    - c. Pipe hangers and supports.
    - d. Tanks that do not have factory-applied final finishes.
    - e. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
    - f. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
    - g. Mechanical equipment that is indicated to have a factory-primed finish for field painting.
  2. Electrical Work:
    - a. Switchgear.
    - b. Panelboards.
    - c. Electrical equipment that is indicated to have a factory-primed finish for field painting.

### 3.4 FIELD QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
1. Owner will engage the services of a qualified testing agency to sample paint materials being used. Samples of material delivered to Project site will be taken, identified, sealed, and certified in presence of Contractor.
  2. Testing agency will perform tests for compliance with product requirements.
  3. 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.

### 3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.
- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

### 3.6 INTERIOR PAINTING SCHEDULE

#### A. Concrete Substrates, Nontraffic Surfaces:

- 1. High-Performance Architectural Latex System: MPI INT 3.1C.
  - a. Prime Coat: Interior latex primer/sealer.
  - b. Intermediate Coat: High-performance architectural latex matching topcoat.
  - c. Topcoat: High-performance architectural latex (semigloss).

#### B. Concrete Substrates, Traffic Surfaces:

- 1. Clear Sealer System: MPI INT 3.2F.
  - a. First Coat: Interior/exterior clear concrete floor sealer (solvent based).
  - b. Topcoat: Interior/exterior clear concrete floor sealer (solvent based).
- 2. Water-Based Clear Sealer System: MPI INT 3.2G.
  - a. First Coat: Interior/exterior clear concrete floor sealer (water based).
  - b. Topcoat: Interior/exterior clear concrete floor sealer (water based).

#### C. Steel Substrates:

- 1. High-Performance Architectural Latex System: MPI INT 5.1R.
  - a. Prime Coat: Alkyd anticorrosive metal primer.
  - b. Intermediate Coat: High-performance architectural latex matching topcoat.(semigloss)
  - c. Topcoat: High-performance architectural latex (semigloss).

#### D. Galvanized-Metal Substrates:

- 1. High-Performance Architectural Latex System: MPI INT 5.3M.
  - a. Prime Coat: Waterborne galvanized-metal primer.
  - b. Intermediate coat: High-performance architectural latex (semigloss).
  - c. Topcoat: High-performance architectural latex (semigloss).

#### E. Gypsum Board Substrates:

- 1. High-Performance Architectural Latex System: MPI INT 9.2B.

- a. Prime Coat: Interior latex primer/sealer.
- b. Intermediate Coat: High-performance architectural latex matching topcoat. ( Flat)
- c. Topcoat: High-performance architectural latex (Flat).

END OF SECTION 099123

SECTION 104416 - FIRE EXTINGUISHERS & CABINETS

PART 1 - GENERAL

1.01 **STANDARD SPECIFICATIONS:** The provisions of the Standard Specifications shall apply except as modified herein.

1.02 **SCOPE:** The Work of this Section shall consist of furnishing all labor, materials, equipment, appliances and services necessary for the execution and completion of all **Fire Extinguishers & Cabinets Work**, as shown on the Plans and as described in the Specifications including, but not necessarily limited to, the following:

- Furnishing and installation of Two (2) new Semi-Recessed fire extinguisher cabinets as shown on the plans and as specified herein
- Coordination with Work of other Sections;
- Clean-up; and,
- Replacements, Repairs, Guarantees and Warranty Work.

1.03 **RELATED WORK:**

Submittals                      Section 01300

1.05 **SUBMITTALS:** Submit copies of each of the following per Special Provisions Section 2-5.3 **Shop Drawings and Submittals** and Technical Specifications Section **01300 Submittals** at the pre-construction conference for the review and approval of the City prior to commencement of any Work:

- A. **Materials Lists/Manufacturer's Product Information:** Contractor shall submit a complete list of materials along with the manufacturer's catalog cuts for all materials proposed for use in the Work at the preconstruction conference. Contractor shall also provide the Manufacturer's complete installation drawings including specifications and a replacement parts lists for all equipment proposed for the Project. Submit copies of all Manufacturer's product information for each item specified for use in the Work.
- B. **Proposed Substitutions:** Submittals for Proposed Substitutions shall conform with Special Provisions Section 4-1.6.1 **Proposed Substitutions**. Products proposed for substitution as "equals" to the products specified are subject to the approval of Parks Department Representative. If at the time proposed equals are delivered to the site it is determined by Parks Department Representative that the products are not equal to the products specified, unacceptable products shall be removed and products as specified provided by Contractor at no additional cost to City.
- C. **Turn Over Items:** The following items shall be turned over to Parks Department Representative at the final acceptance inspection:
  - 1. Operation and Maintenance Manuals
    - a) Warranty Cards
    - b) Maintenance Manuals
    - c) Replacement Parts Lists
  - 2. Documentation of Fire Department's Inspection and acceptance of the Fire Extinguishers and Cabinets.

1.05 **INSPECTIONS:** Contractor shall coordinate with the City Fire Department for inspection of the proposed fire extinguisher cabinet locations prior to installation, and for final inspection of the installed units prior to Final Acceptance of the Work. Obtain written documentation of such inspections and turn-over same to the Park Projects Inspector at the Final Acceptance Inspection.

PART 2 - MATERIALS

2.01 FIRE EXTINGUISHERS & CABINETS:

A. All areas:

1. Extinguishers: shall be multi-purpose dry chemical extinguishers for Class A, B, and C fires, nominal capacity of five (5) pounds with a UL rating of 2A 10B, C. Extinguishers are to be factory finished, painted red. Extinguishers are to be Model No. MP5, as manufactured by Larsen's, or City approved equal.
2. Cabinets: shall be semi-recessed type, with a solid door, with Red Type A die cut lettering. The cabinet door shall have a pull handle and roller catch, and shall be standard Baked on White Paint. The cabinet shall be Model No. AL-2409-6R as manufactured by Larsen's, or City approved equal.

PART 3 - EXECUTION

- 3.01 GENERAL: Extinguishers and cabinets shall be installed in accordance with the manufacturer's recommendations, and fully charged.
- 3.02 CLEAN UP: Upon completion of the Work of this Section, remove all trash, debris and excess materials and dispose of same off site in a legal manner.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Sink

B. Related Sections:

1. Section 07 90 00 - Joint Protection: Product requirements for calking between fixtures and building components for placement by this section.
2. Section 22 11 00 - Facility Water Distribution: Supply connections to plumbing fixtures.
3. Section 22 13 00 - Facility Sanitary Sewerage: Waste connections to plumbing fixtures.
4. Section 26 05 03 - Equipment Wiring Connections: Execution requirements for electric connections to sensor valves and faucets specified by this section.

1.2 REFERENCES

A. Air-Conditioning and Refrigeration Institute:

1. ARI 1010 - Self-Contained, Mechanically Refrigerated Drinking-Water Coolers.

B. American Society of Mechanical Engineers:

1. ASME A112.6.1 - Floor-Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use.
2. ASME A112.18.1 - Plumbing Fixture Fittings.
3. ASME A112.19.1M - Enameled Cast Iron Plumbing Fixtures.
4. ASME A112.19.2M - Vitreous China Plumbing Fixtures.
5. ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
6. ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
7. ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.

1.3 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit catalog illustrations of fixtures, sizes, [rough-in dimensions,] utility sizes, trim, and finishes.
- C. Manufacturer's Installation Instructions: Submit installation methods and procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.



1.4 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.5 QUALITY ASSURANCE

- A. Provide products requiring electrical connections listed and classified by Underwriters Laboratories Inc. as suitable for purpose specified and indicated.
- B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.7 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept fixtures on site in factory packaging. Inspect for damage.
- C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.9 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for plumbing fixtures.

1.10 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of faucet washers, flush valve service kits, and lavatory supply fittings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - FIXTURES

- A. Moen
- B. Kohler

2.2 ACCEPTABLE MANUFACTURERS - EMERGENCY SAFETY EQUIPMENT

- A. Haws
- B. Western
- C. Guardian
- D. Bradley

2.3 SINKS, ACCESSIBLE

- A. Basin: ANSI A112.19.2; stainless steel sink with 3 inch high back, air dual temperature self-closing valve, and rectangular basin with splash lip, integral faucet, front overflow. For model number see schedule on drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify walls and floor finishes are prepared and ready for installation of fixtures.
- C. Verify electric power is available and of correct characteristics.
- D. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

- A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

- A. Install each fixture with trap, easily removable for servicing and cleaning.
- B. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

- C. Install components level and plumb.
- D. Install and secure fixtures in place with wall carriers and bolts.
- E. Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 90 00, color to match fixture.
- F. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.
- G. For ADA accessible water closets, install flush valve with handle to wide side of stall.

### 3.4 INTERFACE WITH OTHER PRODUCTS

- A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

### 3.5 ADJUSTING

- A. Section 01 70 00 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

### 3.6 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean plumbing fixtures and equipment.

### 3.7 PROTECTION OF INSTALLED CONSTRUCTION

- A. Section 01 70 00 - Execution and Closeout Requirements: Protecting installed construction.
- B. Do not permit use of fixtures before final acceptance.

END OF SECTION 22 40 00

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

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pipe hangers and supports.
2. Hanger rods.
3. Flashing.
4. Equipment curbs.
5. Sleeves.
6. Mechanical sleeve seals.
7. Formed steel channel.
8. Equipment bases and supports.

B. Related Sections:

1. Division 07 - Joint Protection: Product requirements for sealant materials for placement by this section.
2. Division 07 - Installation requirements for roof flashing installation.
3. Division 09 - Painting and Coating: Product and execution requirements for painting specified by this section.
4. Division 23 - Refrigerant Piping: Execution requirements for placement of hangers and supports specified by this section.
5. Division 23 - HVAC Ducts and Casings: Execution requirements for placement of hangers and supports specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME B31.5 - Refrigeration Piping.
2. ASME B31.9 - Building Services Piping.

B. ASTM International:

1. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

D. FM Global:

1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
  - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
  - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
  - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
  
- F. Underwriters Laboratories Inc.:
  - 1. UL 263 - Fire Tests of Building Construction and Materials.
  - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
  - 3. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
  - 4. UL - Fire Resistance Directory.
  
- G. Intertek Testing Services (Warnock Hersey Listed):
  - 1. WH - Certification Listings.

### 1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
  
- B. Shop Drawings: Indicate system layout with location including critical dimensions, sizes, pipe hanger and support locations including attachment methods, and detail of trapeze hangers.
  
- C. Product Data:
  - 1. Hangers and Supports: Submit manufacturers catalog data including load capacity.
  
- D. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers.
  
- E. Manufacturer's Installation Instructions:
  - 1. Hangers and Supports: Submit special procedures and assembly of components.
  
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

### 1.4 QUALITY ASSURANCE

- A. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.
  
- B. Perform Work in accordance with applicable authority and AWS D1.1 for welding hanger and support attachments to building structure.

### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.

- B. Installer: Company specializing in performing work of this section with minimum three (3) years documented experience.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

#### 1.7 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Provide ventilation in areas to receive solvent cured materials.

#### 1.8 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.9 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

### PART 2 - PRODUCTS

#### 2.1 PIPE HANGERS AND SUPPORTS

##### A. Manufacturers:

1. Fee and Mason Manufacturing Co.
2. Tolco.
3. Cooper B-Line Systems, Inc.
4. Carpenter & Paterson Inc.
5. Anvil International Inc.
6. Flex-Weld Inc
7. Globe Pipe Hanger Products
8. Michigan Hanger Co.
9. Substitutions: Division 01 - Product Requirements.

##### B. Refrigerant Piping:

1. Conform to ASME B31.5, ASTM F708, MSS SP58, MSS SP69 and MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
3. Hangers for Pipe Sizes 2 inches and Larger: Carbon steel, adjustable, clevis.

4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes 3 inches and Smaller: Cast iron hook.
6. Vertical Support: Steel riser clamp.
7. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
8. Copper Pipe Support: Copper-plated carbon-steel ring, adjustable.
9. Shield for Insulated Piping 2 Inches and Smaller: 18 gage galvanized steel shield over insulation in 180 degree segments, minimum 12 inches long at pipe support.
10. Shields for Vertical Copper Pipe Risers: Sheet lead.
11. All hangers and pipe supports that are exposed to ambient weather shall be made of galvanized steel.

## 2.2 ACCESSORIES

- A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

## 2.3 FLASHING

- A. Metal Flashing: 24 gage thick galvanized steel.
- B. Metal Counterflashing: 22 gage thick galvanized steel.
- C. Lead Flashing:
  1. Waterproofing: 5 lb/sq. ft sheet lead.
  2. Soundproofing: 1 lb/sq. ft sheet lead.
- D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.
- E. Caps: Steel, 22 gage minimum; 16 gage at fire resistant elements.

## 2.4 EQUIPMENT CURBS

- A. Curbs shall be minimum 16 gage, galvanized steel fabricated by metal building fabricator.

## 2.5 SLEEVES

- A. Sleeves for Pipes through Non-fire Rated Floors: 18 gage thick galvanized steel.
- B. Sleeves for Pipes through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.
- C. Sleeves for Round Ductwork: Galvanized steel.
- D. Sealant: Acrylic or polyurethane, two-component type; refer to Division 07.

## 2.6 MECHANICAL SLEEVE SEALS

- A. Manufacturers:

1. Thunderline Link-Seal, Inc.
2. NMP Corporation
3. Substitutions: Division 01 - Product Requirements.

B. Product Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.

## 2.7 FORMED STEEL CHANNEL

### A. Manufacturers:

1. Allied Tube & Conduit Corp.
2. B-Line Systems
3. Unistrut Corp.
4. Midland Ross Corp.
5. Substitutions: Division 01 - Product Requirements.

B. Product Description: Galvanized 12 gage thick steel. With holes 1-1/2 inches on center.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

### 3.2 PREPARATION

- A. Remove incompatible materials affecting bond.
- B. Powder-actuated anchors are not allowed.
- C. Install backing or damming materials to arrest liquid material leakage.
- D. Do not drill or cut structural members.
- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

### 3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Pipe and conduits shall be supported and braced per "B-line Seismic Restraint System" or equal.
- B. Install in accordance with ASME B31.1, ASME B31.5, ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69 and MSS SP 89.
- C. Support horizontal piping as scheduled in Section 3.10.



- D. Arrange hangers to prevent transmission of vibration from piping to building structure and allow for expansion and contraction to hangers and supports.
- E. Install hangers with minimum 1/2 inch space between finished covering and adjacent work.
- F. Place hangers within 12 inches of each horizontal elbow.
- G. Use hangers with 1-1/2 inch minimum vertical adjustment.
- H. Support vertical piping at every floor.
- I. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- J. Support riser piping independently of connected horizontal piping.
- K. Provide copper plated hangers and supports for uninsulated copper piping.
- L. Design hangers for pipe movement without disengagement of supported pipe.
- M. Prime coat exposed steel hangers and supports. Refer to Division 09. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- N. Provide clearance in hangers and from structure and other equipment for installation of specified insulation without cutting pipeline or fitting covering. Refer to Division 22.

#### 3.4 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide curbs for roof installation 14 inches minimum high above roofing surface.
- B. Using templates furnished with equipment to install anchor bolts and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members, formed steel channel or steel pipe and fittings.
- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Division 23.

#### 3.5 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash and seal.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Flash and counter-flash roof curbs with sheet metal; seal watertight. Attach counterflashing to equipment and lap base flashing on roof curbs. Fasten and solder joints.

- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

### 3.6 INSTALLATION - SLEEVES

- A. Exterior watertight entries: Seal with mechanical sleeve seals.
- B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
- C. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing insulation and caulk airtight. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
- D. Install stainless steel escutcheons at finished surfaces.

### 3.7 FIELD QUALITY CONTROL

- A. Division 01 - Quality Requirements and 01 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

### 3.8 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.

### 3.9 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

### 3.10 SCHEDULES

- A. The maximum support spacing for vertical and horizontal pipes shall be as required by the California Plumbing Code, Chapter 3, but not less than that indicated in the table below for horizontal piping.
- B. Copper and Steel Pipe Hanger Spacing – Refer to Mechanical Detail Sheet.
- C. Note 1: Provide hanger at each change of direction and each branch connection. For pipe sizes 6 inches and smaller, subjected to loadings other than weight of pipe and contents.

END OF SECTION 23 05 29

SECTION 23 05 53 - IDENTIFICATION FOR HVAC AND PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Mechanical Identification Materials
2. Plastic Pipe Markers
3. Plastic Duct Markers
4. Plastic Tape
5. Lettering and Graphics
6. Ceiling Tacks

B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting specified by this section.

1.2 REFERENCES

A. American Society of Mechanical Engineers:

1. ASME A13.1 - Scheme for the Identification of Piping Systems.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit manufacturers catalog literature for each product required.
- C. Shop Drawings: Submit list of wording, symbols, letter size, and color coding for mechanical identification.
- D. Samples: Submit two tags, labels and pipe markers size used on project.
- E. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- G. Division 01 - Execution and Closeout Requirements: Closeout procedures.

1.4 QUALITY ASSURANCE

- A. Conform to ASME A13.1 for color scheme for identification of piping systems and accessories.

- B. Maintain one copy of each document on site.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

#### 1.6 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

#### 1.7 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.8 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

### PART 2 - PRODUCTS

#### 2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturers:
  1. Craftmark Identification Systems
  2. Brady (W.H.) Co.; Signmark Div.
  3. Industrial Safety Supply Co., Inc.
  4. Seaton Identification Products
  5. Safety Sign Co.
  6. Substitutions: Division 01 - Product Requirements

#### 2.2 NAMEPLATES

- A. Product Description: Laminated three-layer plastic with engraved black letters on light contrasting background color.

#### 2.3 MECHANICAL IDENTIFICATION MATERIALS

- A. General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division 21, 22 and 23 sections. Where more than single type is specified for application, selection is installer's option but provide single selection for each product category.

## 2.4 PLASTIC PIPE MARKERS

- A. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, preformed to fit around pipe or pipe covering, complying with ANSI A13.1. Larger sizes may have maximum sheet size with spring fastener.
- B. Pressure Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color coded, pressure sensitive vinyl pipe markers, complying with ANSI A13.1.
- C. Insulation: Furnish 1 inch thick molded fiberglass insulation with jacket for each plastic pipe marker to be installed on un-insulated pipes subject to fluid temperature of 125 degree F or greater. Cut length to extend 2 inches beyond each end of plastic pipe marker.
- D. Small Pipes: For external diameters less than 6 inch (including insulation if any), provide full band pipe markers, extending 360 degree around pipe at each location, fastened by one of the following methods:
  - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
  - 2. Adhesive lap joint in pipe marker overlap.
  - 3. Laminated or bonded application of pipe marker to pipe (or insulation).
  - 4. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4 inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2 inch.
- E. Lettering: Manufacturer's standard pre-printed nomenclature that best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with names as shown or specified.
  - 1. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as a separate unit of plastic.

## 2.5 PLASTIC DUCT MARKERS

- A. General: Provide manufacturer's standard laminated plastic, color-coded duct markers. Conform to the following color code:
  - 1. Green: Cold air
  - 2. Yellow: Hot air
  - 3. Yellow/Green: Supply air
  - 4. Blue: Exhaust, outside, return, and mixed air
  - 5. For hazardous exhausts use colors and designs recommended by ANSI A13.1.
- B. Nomenclature: Include the following:
  - 1. Direction of airflow.
  - 2. Duct service (supply, return, exhaust, etc.)

## 2.6 PLASTIC TAPE

- A. General: Provide manufacturer's standard color-coded pressure sensitive (self adhesive) vinyl tape, not less than 3 mils thick.
- B. Width: Provide 1-1/2 inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6 inch, 2-1/2 inch wide tape for larger pipes.
- C. Color: Comply with ANSI A13.1, except where another color selection is indicated.

## 2.7 LETTERING AND GRAPHICS

- A. General: Coordinate names, abbreviations and other designations used in mechanical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated, below or as required for proper identification and operation/maintenance of mechanical systems and equipment.

<u>System</u>	<u>Letters</u>
Refrigerant Suction Line	R.S.L.
Refrigerant Liquid Line	R.L.L.
Gravity Condensate	G.C.

- B. Multiple Systems: Where multiple systems of same generic name are shown and specified, provide identification which indicates individual system number as well as service (as examples; Boiler No. 3, Air Supply No. 1H, Standpipe F12).

## 2.8 CEILING TACKS

- A. Steel with 3/4 inch diameter color coded head.
- B. Color code as follows:
  - 1. Yellow: HVAC equipment.
  - 2. Red: Fire dampers/smoke dampers.
  - 3. Green: Plumbing valves.
  - 4. Blue: Heating/cooling valves.

## PART 3 - EXECUTION

### 3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceiling and similar removable concealment.

### 3.2 DUCTWORK IDENTIFICATION

- A. General: Identify air supply, return, exhaust, intake and relief ductwork with duct markers; showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).
- B. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground, or similar concealment) and at 50 foot spacing along exposed runs.
- C. Access Doors: Provide duct markers or stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate safety and procedural information.

### 3.3 PIPING SYSTEM IDENTIFICATION

- A. General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow. Plastic pipe markers, with application system as indicated under "Materials" in this section. Install on pipe insulation segment where required for hot non-insulated pipes.
- B. Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.
  - 1. Near each valve and control device.
  - 2. Near each branch, excluding short take offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.
  - 3. Near locations where pipes pass through walls or floor/s ceilings, or enter non-accessible to enclosures.
  - 4. At access doors, manholes similar access points which permit view or concealed piping.
  - 5. Near major equipment items and other points of origination and termination.
  - 6. Spaced intermediately at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.
  - 7. On piping above removable acoustical ceilings, except omit intermediately spaced marks.

### 3.4 MECHANICAL EQUIPMENT IDENTIFICATION

- A. General: Install engraved plastic laminate sign or plastic equipment marker on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
  - 1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
  - 2. Meters, gages, thermometers and similar units.
  - 3. Fuel burning units including make-up air units, boilers, furnaces, heaters, stills, absorption units.

4. Heat exchangers, coils, evaporators, cooling towers, heat recovering units and similar equipment.
  5. Fans, blowers, primary balancing dampers and mixing boxes.
  6. Packaged HVAC central station or zone type units.
- B. Lettering Size: Minimum 1/4 inch high lettering for name of unit where viewing distance is less than 2'-0", 1/2 inch high for distance up to 6'-0", and proportionately larger lettering for greater distances. Provide secondary lettering of 2/3 to 3/4 of size of the principal lettering.
- C. Test of Signs: In addition to name of identified unit, provide lettering to distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

### 3.5 ADJUSTING AND CLEANING

- A. Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 05 53



SECTION 23 05 93 - TESTING, ADJUSTING, AND BALANCING FOR HVAC AND PLUMBING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Testing, adjusting, and balancing of air systems.
2. Measurement of final operating condition of HVAC systems.
3. Sound measurement of equipment operating conditions.
4. Vibration measurement of equipment operating conditions.

B. Related Sections:

1. Division 23 - Direct-Digital Control System for HVAC: Requirements for coordination between DDC system and testing, adjusting, and balancing work.

1.2 REFERENCES

A. Associated Air Balance Council:

1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

B. Prior to commencing work, submit proof of latest calibration date of each instrument.

C. Test Reports: Indicate data on AABC MN-1 National Standards for Total System Balance forms containing information indicated in schedules.

D. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

E. Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guarantee.

F. Submit draft copies of report for review prior to final acceptance of Project.

- G. Furnish reports in soft cover, letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- H. Preliminary Submittals: Within 30 days after receipt of above preliminary information and data, the Agency shall submit the following through Contractor:
  - 1. Agenda: Submit 3 sets of complete Agenda including drawings of the entire HVAC system to be balanced. Agenda shall represent final Total System Balance Report as per Chapter 29 of AABC National Standards, 1982, less field test data. Areas of intended field test inputs shall be represented by fully labeled blank spaces.
  - 2. Pre-construction Plan Check and Construction Review Reports: Submit 3 sets of defined in AABC National Standards, 1982 (Chapter 25) including reports:
    - a. Demonstrating complete understanding of the design intent by the Test and Balance Agency.
    - b. Identifying potential problems for performing the Total System Balance and suggesting possible changes to allow most effective Total System Balance.
  - 3. Total System Balance Schedule: Submit 3 sets of this schedule based on critical-path-network-analysis method and furnishing the Contractor and Owner's representative with a planning tool to include the testing and balancing into overall project schedule. Schedule shall consist of graphical and columnar reports and shall be updated periodically to reflect total project schedule.
- I. Guarantee: Submit three (3) sets of AABC National Project Performance Guaranty.
- J. Certifications: Submit the certificates from mechanical Subcontractor as specified hereinafter.
- K. Reports, Test Reports, and Information: Submit six (6) sets as specified herein and Division 01.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of flow measuring stations, balancing valves and rough setting.
- C. Operation and Maintenance Data: Furnish final copy of testing, adjusting, and balancing report inclusion in operating and maintenance manuals.

#### 1.5 WORK BY MECHANICAL SUBCONTRACTOR

- A. Mechanical subcontractor shall certify in writing that the system, as scheduled for balancing, is operational and complete. Completeness shall include not only the physical installation, but mechanical subcontractor's certification that prime movers, fans, pumps, refrigeration machines, boilers, etc., are installed in good working order, and full load performance has been preliminarily tested under certification of mechanical subcontractor. Before any testing and balancing is started, a complete report shall be sent to the Agency.

## 1.6 QUALITY ASSURANCE

- A. Perform work in accordance with AABC MN-1 National Standards for Field Measurement and Instrumentation, Total System Balance.
- B. Maintain one copy of each document on site.
- C. Prior to commencing work, calibrate each instrument to be used and list in the testing and air balance report showing date of calibration. Upon completing work, recalibrate each instrument to assure reliability.

## 1.7 QUALIFICATIONS

- A. Qualifications of Agency: Total systems balance shall be performed by an independent Agency certified by the Associated Air Balance Council (AABC), which specializes in and whose business is dedicated to the testing, adjusting, and verification of HVAC system performance. Work of this section shall conform to AABC Specifications referred to in Chapters 17 through 26 of the AABC National Standards and other criteria as set forth in this Section.
- B. Information furnished to the air balance agency: Agency shall be furnished with the following information and data:
  - 1. Preliminary: Within 30 days after selection and approval:
    - a. Drawings of the work.
    - b. Specifications covering all work to be tested and balanced.
    - c. Written consent.
  - 2. Exceptions: Following shall be furnished as submittals are approved and the work progresses:
    - a. Change orders affecting work to be tested and balanced.
    - b. Copies of approved submittals for work to be tested and balanced, including approved Shop Drawings, equipment submittals and the approved temperature control drawings.
    - c. Project schedule
    - d. Completely operable systems.

## 1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

## 1.9 SEQUENCING

- A. Division 01 - Summary: Work sequence.
- B. Sequence balancing between completion of systems tested and Date of Substantial Completion.

## 1.10 SCHEDULING

- A. Division 01 - Administrative Requirements: Coordination and project conditions.

- B. Schedule and provide assistance in final adjustment and test of life safety, smoke evacuation and smoke control system with Fire Authority.

## PART 2 - PRODUCTS

Not Used.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify systems are complete and operable before commencing work. Verify the following:
  1. Systems are started and operating in safe and normal condition.
  2. Temperature control systems are installed complete and operable.
  3. Proper thermal overload protection is in place for electrical equipment.
  4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
  5. Duct systems are clean of debris.
  6. Fans are rotating correctly.
  7. Fire and volume dampers are in place and open.
  8. Air coil fins are cleaned and combed.
  9. Access doors are closed and duct end caps are in place.
  10. Air outlets are installed and connected.
  11. Duct system leakage is minimized.
  12. Hydronic systems are flushed, filled, and vented.
  13. Pumps are rotating correctly.
  14. Proper strainer baskets are clean and in place or in normal position.
  15. Service and balancing valves are open.

### 3.2 PREPARATION

- A. Furnish instruments required for testing, adjusting, and balancing operations.
- B. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

### 3.3 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within plus or minus 3 percent of design.
- B. Air Outlets and Inlets: Adjust total to within plus or minus 10 percent. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

### 3.4 ADJUSTING

- A. Division 01 - Execution and Closeout Requirements: Testing, adjusting, and balancing.
- B. Verify recorded data represents actual measured or observed conditions.
- C. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- D. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- E. Report defects and deficiencies noted during performance of services, preventing system balance.
- F. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- G. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.
- H. Check and adjust systems approximately six (6) months after final acceptance and submit report.

### 3.5 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude. Provide labor at no additional cost to the Owner to change sheaves and belts as required to accomplish specified fan performance. Mechanical Contractor to provide material as required.
- B. Make air quantity measurements in main ducts by pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust supply air devices to obtain uniform space temperatures free from objectionable drafts.
- E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Adjust volume control by using volume dampers located in branch ducts. Make drive changes, install additional dampers, etc. as may be required on the job at no additional cost to the Owner.
- F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.05 inches positive static pressure near building entries.
- L. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

### 3.6 DUCT PRESSURE TESTING

#### A. General

1. High, medium, and low pressure ductwork systems tested during construction prior to insulation. Test ducts lengths a maximum of 100 feet at time for risers and 150 feet for horizontal ducts. All ductwork tested and approved prior to installation of insulation.
2. Riser branches shall be isolated with seals, plugs, or caps. Riser installed in shafts shall be tested in sections to allow erection of shaft wall and duct insulation as approved by Architect.
3. Tests shall be performed in presence of the Architect who must verify recorded test data for test pressure and air leakage for tested duct length.
4. Test equipment: Rotary blower, calibrated orifice section, and gauge board.
5. Pressure test procedure:
  - a. Check and alert the Mechanical Contractor of any required seals of all openings in duct and plenum section to be tested.
  - b. Connect the test apparatus to test section using a flexible duct connection or hose.
  - c. Close damper on blower suction side, to prevent excessive build-up of pressure.
  - d. Start blower and gradually open damper on suction side of blower.
  - e. Build-up pressure on test section to required limit.
  - f. Determine amount of air leakage by make-up air flow measurements and make repairs as required.
  - g. Total allowable leakage shall not exceed 1% per minute based upon the total operating CFM of the system being tested. Total leakage is determined by summation of leakage for each section of system tested.
  - h. All negative pressure ducts, including return and exhaust system shall be tested by same procedure as positive pressure supply ducts.
  - i. Report final results of duct testing.

#### B. Main Supply Ductwork Systems: Extending from the discharge of supply fans to the inlet of air terminal units.

1. Test pressures: 2 inch WG, 4 inch WG (vertical risers).

2. The allowable leak measured in CFM varies depending upon the length of duct tested and as follows:
  - a. Main duct maximum 1/2% of 1% of the designed CFM on the total length and proportioned to the duct being tested.
  - b. Branch duct or risers maximum 1/2% of 1% of the designed CFM on the total length and proportioned to the duct being tested.
- C. Branch Ductwork Systems: Extending from the air terminal to diffuser, return and exhaust air ducts.
  1. Test pressures: 2 inch WG.
  2. The allowable leak measured in CFM varies depending upon the length of duct tested and as follows:
    - a. Main duct maximum 1/2% of the designed CFM on the total length and proportioned to the duct being tested.
    - b. Branch duct or risers maximum 1/2% of the designed CFM on the total length and proportioned to the duct being tested.
  3. The allowable leakage shall not exceed 1% per minute based upon the total peak operating CFM of system being tested. Total leakage is determined by summation of leakage for each section of the system tested.
- D. Leak tests shall be performed and recorded separately for each system for:
  1. Main duct.
  2. Branch duct or risers.
  3. Complete system.
- E. Test Failures: Notify General Contractor to repair duct system if test pressure and leakage is not attained. Repairs and sealing to be done with sheet metal and sealant by Mechanical Contractor.

### 3.7 SOUND TEST PROCEDURES

- A. Test Conditions: Any deem necessary, sound level measurements shall be taken at times when the building is unoccupied, or when activity in surrounding areas and background noise levels in areas tested are at a minimum and are relatively free from sudden changes in noise levels. Measurements shall be taken with all equipment secured, except that being tested. Test conditions shall be as directed by the Engineer.
- B. Measurements: Required sound levels shall be measured at any point within a room not less than 6 feet from an air terminal or room unit and no closer than 3 feet from any floor, wall, or ceiling surface.
- C. Test Instrument: Measure surface levels with General Radio Model 19829720 Sound Analysis System 30-140 DB Octave Bank Analyzer; "A" scale shall be used to measure overall sound levels. Specified octave banks levels shall be determined with above sound level meter set on "A."

### 3.8 SCHEDULES

#### A. Equipment Requiring Testing, Adjusting, and Balancing:

1. Packaged Roof Top Indirect Fired Furnaces (make-up air unit).
2. Air Cooled Refrigerant Condensers.
3. Packaged Roof Top Heating/Cooling Units.
4. Fans.
5. Air Filters.
6. Air Inlets and Outlets.

#### B. Report Forms

1. Title Page:
  - a. Name of Testing, Adjusting, and Balancing Agency
  - b. Address of Testing, Adjusting, and Balancing Agency
  - c. Telephone and facsimile numbers of Testing, Adjusting, and Balancing Agency
  - d. Project name
  - e. Project location
  - f. Project Architect
  - g. Project Engineer
  - h. Project Contractor
  - i. Project altitude
  - j. Report date
2. Summary Comments:
  - a. Design versus final performance
  - b. Notable characteristics of system
  - c. Description of systems operation sequence
  - d. Summary of outdoor and exhaust flows to indicate building pressurization
  - e. Nomenclature used throughout report
  - f. Test conditions
3. Instrument List:
  - a. Instrument
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Range
  - f. Calibration date
4. Electric Motors:
  - a. Manufacturer
  - b. Model/Frame
  - c. HP/BHP and kW
  - d. Phase, voltage, amperage; nameplate, actual, no load
  - e. RPM
  - f. Service factor
  - g. Starter size, rating, heater elements
  - h. Sheave Make/Size/Bore
5. V-Belt Drive:
  - a. Identification/location



- b. Required driven RPM
  - c. Driven sheave, diameter and RPM
  - d. Belt, size and quantity
  - e. Motor sheave diameter and RPM
  - f. Center to center distance, maximum, minimum, and actual
6. Combustion Test:
- a. Manufacturer
  - b. Model number
  - c. Serial number
  - d. Firing rate
  - e. Overfire draft
  - f. Gas meter timing dial size
  - g. Gas meter time per revolution
  - h. Gas pressure at meter outlet
  - i. Gas flow rate
  - j. Heat input
  - k. Burner manifold gas pressure
  - l. Percent carbon monoxide (CO)
  - m. Percent carbon dioxide (CO<sub>2</sub>)
  - n. Percent oxygen (O<sub>2</sub>)
  - o. Percent excess air
  - p. Flue gas temperature at outlet
  - q. Ambient temperature
  - r. Net stack temperature
  - s. Percent stack loss
  - t. Percent combustion efficiency
  - u. Heat output
7. Air Cooled Condenser:
- a. Identification/number
  - b. Location
  - c. Manufacturer
  - d. Model number
  - e. Serial number
  - f. Entering DB air temperature, design and actual
  - g. Leaving DB air temperature, design and actual
  - h. Number of compressors
8. Cooling Coil Data:
- a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Entering air DB temperature, design and actual
  - g. Entering air WB temperature, design and actual
  - h. Leaving air DB temperature, design and actual
  - i. Leaving air WB temperature, design and actual
  - j. Water flow, design and actual
  - k. Water pressure drop, design and actual
  - l. Entering water temperature, design and actual

- m. Leaving water temperature, design and actual
- n. Saturated suction temperature, design and actual
- o. Air pressure drop, design and actual
- 9. Heating Coil Data:
  - a. Identification/number
  - b. Location
  - c. Service
  - d. Manufacturer
  - e. Air flow, design and actual
  - f. Water flow, design and actual
  - g. Water pressure drop, design and actual
  - h. Entering water temperature, design and actual
  - i. Leaving water temperature, design and actual
  - j. Entering air temperature, design and actual
  - k. Leaving air temperature, design and actual
  - l. Air pressure drop, design and actual
- 10. Air Moving Equipment:
  - a. Location
  - b. Manufacturer
  - c. Model number
  - d. Serial number
  - e. Arrangement/Class/Discharge
  - f. Air flow, specified and actual
  - g. Return air flow, specified and actual
  - h. Outside air flow, specified and actual
  - i. Total static pressure (total external), specified and actual
  - j. Inlet pressure
  - k. Discharge pressure
  - l. Sheave Make/Size/Bore
  - m. Number of Belts/Make/Size
  - n. Fan RPM
- 11. Return Air/Outside Air Data:
  - a. Identification/location
  - b. Design air flow
  - c. Actual air flow
  - d. Design return air flow
  - e. Actual return air flow
  - f. Design outside air flow
  - g. Actual outside air flow
  - h. Return air temperature
  - i. Outside air temperature
  - j. Required mixed air temperature
  - k. Actual mixed air temperature
  - l. Design outside/return air ratio
  - m. Actual outside/return air ratio
- 12. Exhaust Fan Data:
  - a. Location
  - b. Manufacturer
  - c. Model number

- d. Serial number
  - e. Air flow, specified and actual
  - f. Total static pressure (total external), specified and actual
  - g. Inlet pressure
  - h. Discharge pressure
  - i. Sheave Make/Size/Bore
  - j. Number of Belts/Make/Size
  - k. Fan RPM
13. Duct Traverse:
- a. System zone/branch
  - b. Duct size
  - c. Area
  - d. Design velocity
  - e. Design air flow
  - f. Test velocity
  - g. Test air flow
  - h. Duct static pressure
  - i. Air temperature
  - j. Air correction factor
14. Duct Leak Test:
- a. Description of ductwork under test
  - b. Duct design operating pressure
  - c. Duct design test static pressure
  - d. Duct capacity, air flow
  - e. Maximum allowable leakage duct capacity times leak factor
  - f. Test apparatus
    - 1) Blower
    - 2) Orifice, tube size
    - 3) Orifice size
    - 4) Calibrated
  - g. Test static pressure
  - h. Test orifice differential pressure
  - i. Leakage
15. Air Distribution Test Sheet:
- a. Air terminal number
  - b. Room number/location
  - c. Terminal type
  - d. Terminal size
  - e. Area factor
  - f. Design velocity
  - g. Design air flow
  - h. Test (final) velocity
  - i. Test (final) air flow
  - j. Percent of design air flow
16. Sound Level Report:
- a. Location
  - b. Octave bands - equipment off
  - c. Octave bands - equipment on
  - d. RC level - equipment on

17. Vibration Test:

- a. Location of points:
  - 1) Fan bearing, drive end
  - 2) Fan bearing, opposite end
  - 3) Motor bearing, center (when applicable)
  - 4) Motor bearing, drive end
  - 5) Motor bearing, opposite end
  - 6) Casing (bottom or top)
  - 7) Casing (side)
  - 8) Duct after flexible connection (supply air)
  - 9) Duct after flexible connection (exhaust/return air)
- b. Test readings:
  - 1) Horizontal, velocity and displacement
  - 2) Vertical, velocity and displacement
  - 3) Axial, velocity and displacement
- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (when non-complying)

3.9 TOTAL SYSTEM PERFORMANCE VERIFICATION

- A. Immediately on completion of the system testing and balancing, the Agency shall conduct a 7-day continuous total system performance and capacity test; the Contractor shall supply all energy and consumables and/or materials required for the test.
- B. General: Outdoor DB and WB air temperatures and actual operating data for this test shall be taken simultaneously and hourly on all energy consuming equipment of cooling and heating plants and on any air and/or water distribution equipment which deviates more than 10% from design specifications.
- C. Data Conversion and Reports: The data collected during this test shall be converted to KWH per ton for cooling equipment and KWH per MBH for the heating equipment and shall cover a minimum of four points on the equipment operating curve. These points shall be at 25%, 50%, 75% and 100% of full load test. Reports shall be prepared and submitted for all data and conversion.

END OF SECTION 23 05 93

## SECTION 23 07 00- HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. HVAC insulation, jackets and accessories.
2. HVAC ductwork insulation, jackets, and accessories.
3. Insulation accessories including vapor retarders and accessories.

##### B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
2. Division 23 - Hangers and Supports for HVAC and Plumbing Piping and Equipment: Product and Execution requirements for inserts at hanger locations.
3. Division 23 - Identification for HVAC and Plumbing Piping and Equipment: Product requirements for HVAC piping and equipment identification.

#### 1.2 REFERENCES

##### A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
4. ASTM C449 - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
5. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
9. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
10. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
11. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
12. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
13. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

14. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
15. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
16. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
17. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
18. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
19. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible, latest edition.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
2. UL 1978 - Standard for Safety for Grease Ducts.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials, R value, finished accessories and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.4 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum three years documented experience.

### 1.5 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.
- D. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index of 25 or less, and smoke developed index of 50 or less, in accordance with UBC standard No. 42-1 except where more stringent requirements are noted.
- E. Insulation materials shall be tested by Underwriters Laboratories, Inc. (UL). Tests shall include insulation, jackets, fittings, adhesives, coatings and accessories. Composite products shall meet the fire hazard requirements of NFPA 90A.
- F. Furnish affidavit from manufacturer that products delivered to project meet requirements specified
- G. Maintain one (1) copy of each document on site.

### 1.6 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

### 1.7 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping.

### 1.8 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

## 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

## 1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five (5) year manufacturer warranty for manmade fiber.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURER

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following.
  - 1. Owens-Corning.
  - 2. Armstrong World Industries, Inc.
  - 3. CertainTeed.
  - 4. Knauf.
  - 5. Rubatex Corp.
  - 6. Johns Manville.
  - 7. Substitutions: Division 01 - Product Requirements

### 2.2 PIPE INSULATION

- A. Fiberglass (Mineral Fiber) Piping Insulation: ASTM C547, Class 1 unless otherwise indicated. Owens Corning "Fiberglass Evolution", ASJ, Johns Manville Products Corp. "Micro-Lok", or equivalent.
- B. Jackets for Piping Insulation: ASTM C921, Type I (Vapor Barrier) for piping with temperatures below ambient.
  - 1. Encase pipe fittings insulation with one-piece remolded PVC fitting covers, fastened per manufacturer's recommendations.
  - 2. Encase exterior piping insulation with aluminum or stainless steel jacket with moisture barrier. Secure in accordance with manufacturer's recommendations. Joints shall be applied so they will shed water and shall be sealed completely.
- C. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- D. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.



### 2.3 DUCTWORK INSULATION MATERIALS

- A. Rigid Fiberglass Ductwork Insulation: ASTM C612, Class 1, 3-5 lbs/ft<sup>3</sup>.
- B. Flexible Fiberglass Ductwork Insulation: ASTM C1290, with ASTM C1136 Type II vapor barrier jacket. Owens-Corning Fiberglass All Service Wrap Insulation, Type 75 or equivalent R-value:
  - 1. R-8 minimum installed insulation for all supply ducts for all "other" spaces not listed above (i.e., conditioned space). Not required for ductwork exposed in space being served (i.e. gym).
  - 2. Density of 0.75 pcf (Type 75) and nominal thicknesses below shall be used to provide installed R-value as follows:
    - a. Type 75      2"      Thick R = 8
- C. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- D. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

### 2.4 PIPE INSULATION JACKETS

- A. Aluminum Pipe Jacket:
  - 1. ASTM B209.
  - 2. Thickness: 0.025 inch thick sheet.
  - 3. Finish: Embossed.
  - 4. Joining: Longitudinal slip joints and 2 inch laps.
  - 5. Fittings: 0.016 inch thick die shaped fitting covers with factory attached protective liner.
  - 6. Metal Jacket Bands: 3/8 inch wide; 0.015 inch thick aluminum.
- B. Stainless Steel Pipe Jacket:
  - 1. ASTM A167 Type 302, 304 or 316 stainless steel.
  - 2. Thickness: 0.016 inch thick.
  - 3. Finish: Corrugated.
  - 4. Metal Jacket Bands: 3/8 inch wide; 0.010 inch thick stainless steel.
- C. Field Applied Jacket System:
  - 1. ASTM C 921, Type 1.
  - 2. Aluminum Jacket: Stucco-embossed finish sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness shall be 0.024" for outdoor applications.
    - a. Moisture Barrier: 3-mil- thick, heat-bonded polyethylene or Kraft paper.

3. Stainless Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A666, Type 304 or 316, 0.016 inch thick, and roll stock ready for shop or field cutting and forming to indicated sizes.
  - a. Moisture Barrier: 3 mil thick, heat bonded polyethylene and kraft paper.
  - b. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

## 2.5 INSULATING CEMENTS (DUCTWORK AND EQUIPMENT)

- A. Mineral Fiber Insulating Cement: Comply with ASTM C 195.

1. Manufacturers:
  - a. Insulco, Division of MFS, Inc.: Triple I.
  - b. Ramco. Insulation, Inc.: Super-Stik
  - c. Substitutions: Division 01 - Product Requirements.

- B. Mineral Fiber Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Manufacturers:
  - a. Insulco, Division of MFS, Inc.: SmoothKote.
  - b. Ramco Insulation, Inc.: P.K. No. 127 and Quick-Cote
  - c. Rock Wool Manufacturing Co.; Delta One Shot
  - d. Substitutions: Division 01 - Product Requirements.

## 2.6 ADHESIVES (DUCTWORK)

- A. Manufacturers:

1. Childers Products, Division of ITW; CP-82.
2. Foster Products Corporation, H. B. Fuller Company; 85-20.
3. ITW TACC, Division of Illinois Tool Works; S-90/80
4. Marathon Industries, Inc.; 225
5. Mon-Eco Industries, Inc.; 22-25
  - a. Substitutions: Division 01 - Product Requirements.

- B. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

- C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

## 2.7 MASTICS (DUCTWORK)

- A. Manufacturers:

1. Childers Products, Division of ITW; CP-35.
2. Foster Products Corporation, H. B. Fuller Company; 30-90.
3. ITW TACC, Division of Illinois Tool Works; CB-50
4. Marathon Industries, Inc.; 590
5. Mon-Eco Industries, Inc.; 55-40

6. Vimasco Corp.; 749
7. Or equal

- B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.
- C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
- D. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
- E. Service Temperature Range: Minus 20 to plus 180 degrees F.
- F. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
- G. Color: White.

## 2.8 SEALANTS

### A. FSK and Metal Jacket:

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

### B. ASJ Flashing Sealants (Ductwork):

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

## 2.9 ACCESSORIES AND ATTACHMENTS

- A. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
  1. Welded Pin Holding Capacity: 20 lb for direct pull perpendicular to the attached surface.

- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated. May be used for heating and hot water systems.
  - 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 20 lb for direct pull perpendicular to the adhered surface.
- C. Wire: 0.080 inch, nickel copper alloy, 0.062 inch soft annealed stainless steel, or 0.062 inch soft annealed galvanized steel.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Examine areas and conditions which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
- C. Verify piping, equipment and ductwork has been tested before applying insulation materials.
- D. Verify surfaces are clean and dry, with foreign material removed.

#### 3.2 HVAC PIPING SYSTEM INSULATION

- A. Insulation Omitted: Omit insulation on hot unions, flanges, strainers, flexible connections and expansion joints.
- B. Refrigerant Piping:
  - 1. Application Requirements: Insulate the cold HVAC piping systems for HVAC chilled water supply and return piping.
  - 2. Insulate each piping system specified above with fiberglass with wicking technology, 1 inch.

#### 3.3 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.

- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Butt piping insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For chilled water piping apply insulation with wicking technology with 3 inch wide paperless tape over the butt joints.
- I. Pipe exposed to weather: Encase exterior piping with aluminum jacket with weather proof construction.
- J. Pipes in mechanical rooms and equipment room. Use pipe insulation with paperless polymer jacketing or encase piping with PVC cover.
- K. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. Provide high density insulation of same thickness where saddles or protection shields all located. In case where insulation with wicking technology is used, cover evaporation grid holes with paperless tape under length of saddles or shields.

#### 3.4 DUCTWORK SYSTEM INSULATION:

- A. Insulation Omitted: Do not insulate lined ductwork.
- B. Ductwork:
  - 1. Application Requirements: Insulate the following ductwork:
    - a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet, insulate to R-8,
    - b. HVAC supply ductwork, unconditioned space R-8, above ceiling grid indirectly conditioned space R-8..
    - c. HVAC return ductwork, unconditioned space R-8, above ceiling grid indirectly conditioned space R-8.
  - 2. Insulate each ductwork system specified above with one of the following types and thickness of insulation as indicated:
    - a. Rigid Fiberglass: 2 inch thick, (Owens Corning 703 FRK R-8), in machine, fan and equipment rooms.
    - b. Flexible Fiberglass: Type 75 (0.75 pcf), 2" inch thick in conditioned space (R-8) or 3 inch thick in unconditioned space (R-8), , application limited to concealed locations.

### 3.5 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined ductwork: Except as otherwise indicated, omit external insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- G. Ductwork Exposed to Weather: Cover exposed to weather duct insulation with 26 gauge galvanized sheet metal, sides, top and bottom with standing seams. Pitch for drainage.
- H. Ductwork and sheet metal plenums exposed to view (Ductwork in the mechanical rooms): Insulate to California Title 24 requirements. If space is unconditioned provide 3 inch thick, 3/4 pounds per cubic foot density FRK faced glass fiber blanket. If space is indirectly conditioned, provide 1-1/2 inch thick 3/4 pounds per cubic foot density FRK faced glass fiber blanket. Tightly butt joints. Secure with 18 gauge tie wire. Corner angles shall overlap at least two sheet metal screws at each side.

### 3.6 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damaged and deterioration.

END OF SECTION 23 07 00

## SECTION 23 11 23 - FACILITY NATURAL-GAS PIPING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Natural gas piping buried.
2. Natural gas piping above grade.
3. Unions and flanges.
4. Underground pipe markers.
5. Bedding and cover materials.

##### B. Related Sections:

1. Section 05 12 00 - Structural Steel Framing: Product requirements for touch-up painting of structural steel.
2. Section 05 21 00 - Steel Joist Framing: Product requirements for touch-up painting of steel joists.
3. Section 07 84 00 - Firestopping: Product requirements for firestopping for placement by this section.
4. Section 08 31 13 - Access Doors and Frames: Access doors for concealed valves and accessories.
5. Section 09 90 00 - Painting and Coating: Product requirements for painting for placement by this section.
6. Section 23 05 03 - Pipes and Tubes for HVAC Piping and Equipment: Piping materials for gas piping systems.
7. Section 23 05 23 - General-Duty Valves for HVAC Piping: Valves for gas piping systems.
8. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for pipe hangers and supports and firestopping for placement by this section.
9. Section 23 05 53 - Identification for HVAC Piping and Equipment: Product requirements for valve and pipe identification for placement by this section.
10. Section 31 05 13 - Soils for Earthwork: Soils for backfill in trenches.
11. Section 31 05 16 - Aggregates for Earthwork: Aggregate for backfill in trenches.
12. Section 31 23 16 - Excavation: Product and execution requirements for excavation and backfill required by this section.
13. Section 31 23 17 - Trenching: Execution requirements for trenching required by this section.
14. Section 31 23 23 - Fill: Requirements for backfill to be placed by this section.
15. Section 33 51 00 - Natural-Gas Distribution: Product and execution requirements for site natural gas distribution systems.

#### 1.2 REFERENCES

##### A. American National Standards Institute:

1. ANSI Z21.15 - Manually Operated Gas Valves for Appliances, Appliance Connector Valves and Hose End Valves.

B. American Society of Mechanical Engineers:

1. ASME B16.33 - Manually Operated Metallic Gas Valves for Use in Gas Piping Systems Up to 125 psig (sizes 1/2 - 2).
2. ASME B31.9 - Building Services Piping.

C. ASTM International:

1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A234/A234M - Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
3. ASTM D2513 - Standard Specification for Thermoplastic Gas Pressure Pipe, Tubing and Fittings.
4. ASTM D2683 - Standard Specification for Socket Type Polyethylene Fittings for Outside Diameter Controlled Polyethylene Pipe and Tubing
5. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.

D. American Welding Society:

1. AWS D1.1 - Structural Welding Code - Steel.

E. American Water Works Association:

1. AWWA C105 - American National Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems.

F. Manufacturers Standardization Society of the Valve and Fittings Industry:

1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
3. MSS SP 78 - Cast Iron Plug Valves, Flanged and Threaded Ends.
4. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

G. National Fire Protection Association:

1. NFPA 54 - National Fuel Gas Code.

H. Underwriters Laboratories Inc.:

1. UL 842 - Valves for Flammable Fluids.

1.3 SYSTEM DESCRIPTION

- A. Where more than one piping system material is specified, provide compatible system components and joints. Use non-conducting dielectric connections when joining dissimilar metals in systems.



- B. Provide flanges, unions, or couplings at locations requiring servicing. Use unions, flanges, or couplings downstream of valves and at equipment connections. Do not use direct welded or threaded connections to valves, equipment.
- C. Provide pipe hangers and supports in accordance with ASME B31.9, ASTM F708, MSS SP 58, MSS SP 69, and MSS SP 89.
- D. Use ball or gas cocks valves for shut-off and to isolate equipment, part of systems, or vertical risers.

#### 1.4 SUBMITTALS

- A. Section 01 33 00 - Submittal Procedures: Submittal procedures.
- B. Product Data:
  - 1. Piping: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information.
  - 2. Valves: Submit manufacturers catalog information with valve data and ratings for each service.
  - 3. Hangers and Supports: Submit manufacturers catalog information including load capacity.
  - 4. Piping Specialties: Submit manufacturers catalog information including capacity, rough-in requirements, and service sizes.
- C. Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- D. Test Reports: Indicate results of piping system pressure test.
- E. Manufacturer's Certificate: Certify Products meet or exceed specified requirements
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within previous 12 months.

#### 1.5 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves, piping system, and system components.
- C. Operation and Maintenance Data: Submit for valves installation instructions, spare parts lists.

#### 1.6 QUALITY ASSURANCE

- A. Perform natural gas Work in accordance with NFPA 54.
- B. Perform work in accordance with CPC.

- C. Perform Work in accordance with ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.
- D. Perform Work in accordance with applicable code AWS D1.1 for welding hanger and support attachments to building structure.
- E. Furnish shutoff valves complying with ASME B16.33 or ANSI Z21.15.
- F. Maintain one copy of each document on site.

#### 1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.
- C. Design hangers and supports under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.

#### 1.8 PRE-INSTALLATION MEETINGS

- A. Section 01 30 00 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

#### 1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.
- B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
- C. Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation. Furnish temporary protective coating on cast iron and steel valves.

#### 1.10 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - Product Requirements.
- B. Do not install underground piping when bedding is wet or frozen.

#### 1.11 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.12 COORDINATION

- A. Section 01 30 00 - Administrative Requirements: Requirements for coordination.

- B. Coordinate trenching, excavating, bedding and backfilling of buried piping systems.

1.13 WARRANTY

- A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for valves excluding packing.

1.14 EXTRA MATERIALS

- A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two packing kits for each type and size valve.

PART 2 - PRODUCTS

2.1 NATURAL GAS PIPING, BURIED WITHIN 5 FEET OF BUILDING

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
  - 1. Fittings: ASTM A234/A234M forged steel welding type.
  - 2. Joints: ASME B31.9, welded.
  - 3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped, 10 mil polyethylene tape.
  - 4. High density polyethylene pipe and fittings in accordance with ASTM D-2513, Grades 2306, 3306, and 3408 with fusion joints only, similar to Driscopipe 8100-DRII Series.

2.2 NATURAL GAS PIPING, BURIED BEYOND 5 FEET OF BUILDING

- A. Polyethylene Pipe: ASTM D2513, SDR 11.5. Fittings: ASTM D2683 or ASTM D2513 socket type. Joints: Fusion welded; plastic to steel connections with ASTM D2513 transition fittings or risers. Pipe shall be buried 30 inches deep and backfill with sand, including identification tape and #14 insulated copper tracer wire.
- B. Transition riser from below grade polyethylene pipe to above grade steel pipe; ASTM D2513, Schedule 40 steel epoxy coated casing welded or threaded end, the polyethylene end shall be fusion welded, as manufactured by "Central" or equal.

2.3 NATURAL GAS PIPING, ABOVE GRADE

- A. Steel Pipe: ASTM A53/A53M Schedule 40 black.
  - 1. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
  - 2. Joints: Threaded for pipe 2 inch and smaller; welded for pipe 2-1/2 inches and larger.

2.4 UNIONS AND FLANGES

- A. Unions for Pipe 2 inches and Smaller:

1. Ferrous Piping: Class 150, malleable iron, threaded.
  2. Copper Piping: Class 150, bronze unions with soldered.
  3. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.
- B. Flanges for Pipe 2-1/2 inches and Larger:
1. Ferrous Piping: Class 150, forged steel, slip-on flanges.
  2. Copper Piping: Class 150, slip-on bronze flanges.
  3. Gaskets: 1/16 inch thick preformed neoprene gaskets.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. 01300 - Administrative Requirements: Coordination and project conditions.
- B. Verify excavations are to required grade, dry, and not over-excavated.

#### 3.2 PREPARATION

- A. Ream pipe and tube ends. Remove burrs.
- B. Remove scale and dirt, on inside and outside, before assembly.
- C. Prepare piping connections to equipment with flanges or unions.

#### 3.3 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install hangers and supports in accordance with ASME B31.9, ASTM F708, and MSS SP 89.
- B. Support horizontal piping hangers as scheduled.
- C. Install hangers to provide minimum 1/2 inch space between finished covering and adjacent work.
- D. Place hangers within 12 inches of each horizontal elbow.
- E. Install hangers to allow 1-1/2 inch minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- F. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
- G. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.

- H. Prime coat exposed steel hangers and supports in accordance with Section 09 90 00. Finish paint exposed steel hangers and supports in accordance with Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- I. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

### 3.4 INSTALLATION - BURIED PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Verify connection to existing piping system size, location, and invert are as indicated on Drawings.
- C. Establish elevations of buried piping with not less than 1 ft of cover.
- D. Establish minimum separation of 1 from other services piping in accordance with CPC code.
- E. Remove scale and dirt on inside of piping before assembly.
- F. Excavate pipe trench in accordance with Section 31 23 16 and 31 23 17.
- G. Install pipe to elevation as indicated on Drawings.
- H. Place bedding material at trench bottom to provide uniform bedding for piping, level bedding materials in one continuous layer not exceeding 6 inches compacted depth; compact to 95 percent maximum density.
- I. Install pipe on prepared bedding.
- J. Route pipe in straight line.
- K. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- L. Install trace wire continuous over top of pipe, buried 6 inches below pipe line.
- M. Pipe Cover and Backfilling:
  - 1. Backfill trench in accordance with Section 31 23 23.
  - 2. Maintain optimum moisture content of fill material to attain required compaction density.
  - 3. After hydrostatic test, evenly backfill entire trench width by hand placing backfill material and hand tamping in 6 inches compacted layers to 12 inches minimum cover over top of jacket. Compact to 95 percent maximum density.
  - 4. Evenly and continuously backfill remaining trench depth in uniform layers with backfill material.
  - 5. Do not use wheeled or tracked vehicles for tamping.

### 3.5 INSTALLATION - ABOVE GROUND PIPING SYSTEMS

- A. Install natural gas piping in accordance with NFPA 54.
- B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
- C. Route piping in orderly manner and maintain gradient.
- D. Where required, bend pipe with pipe bending tools in accordance with procedures intended for that purpose.
- E. Install piping to conserve building space and not interfere with use of space.
- F. Size and install gas piping to provide sufficient gas to supply maximum appliance demand at pressure higher than appliance minimum inlet pressure.
- G. Group piping whenever practical at common elevations.
- H. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- I. Sleeve pipe passing through partitions, walls and floors. Refer to Section 23 05 29.
- J. Install firestopping at fire rated construction perimeters and openings containing penetrating sleeves and piping. Refer to Section 07 84 00 and 23 05 29.
- K. Provide clearance for installation of insulation and access to valves and fittings.
- L. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 13.
- M. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer. Refer to Section 05 12 00 and 05 21 00.
- N. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finish painting. Refer to Section 09 90 00.
- O. Install identification on piping systems including underground piping. Refer to Section 23 05 53.
- P. Install valves with stems upright or horizontal, not inverted.
- Q. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

### 3.6 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements and 01 70 00 - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Where gas appliance will be damaged by test pressure, disconnect appliance and cap piping during pressure test. Reconnect appliance after pressure test and leak test connection.
- C. Where gas appliance is designed for operating pressures equal to or greater than piping test pressure, provide gas valve to isolate appliance or equipment from gas test pressure.
- D. Pressure test natural gas piping in accordance with NFPA 54.
- E. Where new branch piping is extended from existing system, pressure test new branch piping only. Leak test joint between new and existing piping with noncorrosive leak detection fluid or other approved method.
- F. When pressure tests do not meet specified requirements, remove defective work, replace and retest.
- G. Immediately after gas is applied to a new system, or a system has been restored after gas service interruption, check pipe for leakage.
  - 1. Where leakage is detected, shut off gas supply until necessary repairs are complete.
- H. Do not place appliances in service until leak testing and repairs are complete.

3.7 SCHEDULES

A. Pipe Hanger Spacing:

PIPE SIZE Inches	COPPER TUBING MAXIMUM HANGER SPACING Feet	STEEL PIPE MAXIMUM HANGER SPACING Feet	COPPER TUBING MINIMUM HANGER ROD DIAMETER Inches	STEEL PIPE MINIMUM HANGER ROD DIAMETER Inches
1/2	4	6	3/8	3/8
3/4	6	7	3/8	3/8
1	6	7	3/8	3/8
1-1/4	8	7	3/8	3/8
1-1/2	8	9	3/8	3/8
2	8	10	3/8	3/8
2-1/2	8	10	1/2	1/2
3	8	10	1/2	1/2
4	8	10	1/2	5/8
5	8	10	1/2	5/8
6	8	10	5/8	3/4
8	8	10	3/4	3/4

END OF SECTION 23 11 23

## SECTION 23 31 00 - HVAC DUCTS AND CASINGS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Duct Materials.
2. Insulated flexible ducts.
3. Single wall spiral round ducts.
4. Transverse duct connection system.
5. Ductwork fabrication.
6. Duct cleaning.

##### B. Related Sections:

1. Division 09 - Painting and Coating: Execution requirements for Weld priming, weather resistant, paint or coating specified by this section.
2. Division 23 - Hangers and Supports for HVAC and Plumbing Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
3. Division 23 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

#### 1.2 REFERENCES

##### A. ASTM International:

1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
2. ASTM A90/A90M - Standard Test Method for Weight Mass of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
4. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
5. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
6. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
8. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
9. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.



B. California Mechanical Code

1. CMC - State of California Mechanical Code

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - Fibrous Glass Duct Construction Standards.
2. SMACNA - HVAC Air Duct Leakage Test Manual.
3. SMACNA - HVAC Duct Construction Standard - Metal and Flexible, latest edition.

E. Underwriters Laboratories Inc.:

1. UL 181 - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

- A. Variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is not permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts, if it is not shown on the drawings.

1.4 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Submit duct fabrication drawings, drawn to scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as Contract Documents, indicating:

1. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work.
2. Duct layout, indicating pressure classifications and sizes in plan view. For exhaust duct systems, indicate classification of materials handled as defined in this section.
3. Fittings.
4. Reinforcing details and spacing.
5. Seam and joint construction details.
6. Penetrations through fire rated and other walls.
7. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
8. Equipment service clearance, access panels and door swings.

- C. Product Data: Submit data for duct materials, duct liner and duct connectors.

- D. Test Reports: Indicate pressure tests performed. Include date; section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.5 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Construct ductwork to NFPA 90A and NFPA 90B standards.
- C. Maintain one (1) copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience approved by manufacturer.

1.8 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum three (3) weeks prior to commencing work of this section.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Division 01 - Product Requirements.
- B. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.
- C. Maintain temperatures during and after installation of duct sealant.

1.10 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

## PART 2 - PRODUCTS

### 2.1 DUCT MATERIALS

- A. Galvanized Steel Ducts: ASTM A653/A653M galvanized steel sheet, lock-forming quality, having G90 zinc coating of in conformance with ASTM A90/A90M.
- B. Steel Ducts: ASTM A1008/A1008M, ASTM A1011/A1011M, ASTM A568/A568M.
- C. Fasteners: Rivets, bolts, or sheet metal screws.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

### 2.2 INSULATED FLEXIBLE DUCTS

#### A. Manufacturers:

- 1. Casco
- 2. Atco
- 3. Thermaflex
- 4. Substitutions: Division 01 - Product Requirements.

- B. Product Description: Flexible duct shall consist of an exterior reinforced laminated vapor barrier, 1-1/2 inch thick fiberglass insulation ( $K = .25 @ 75 \text{ degrees F}$ ), encapsulated spring steel wire helix and impervious, smooth, non-perforated interior vinyl liner. Individual lengths of flexible ducts shall contain factory fabricated steel connection collars. Flexible fiberglass duct shall meet the requirements of NFPA No. 90A and UL 181.

- 1. Pressure Rating: 2 inches wg positive and 0.5 inches wg negative.
- 2. Maximum Velocity: 4000 fpm.
- 3. Temperature Range: -0 degrees F to 200 degrees F.
- 4. Furnish each flexible duct section with integral clamping devices for connection to round or oval fittings.
- 5. Join each flexible duct section to main trunk duct through sheet metal fittings. Construct fittings of galvanized steel and equip with factory installed volume damper having positive locking regulator. Provide fittings installed in lined ductwork with insulation guard.
- 6. Flexible ducts shall be supported at or near mid-length with 2 inch wide, 28 gage steel hanger collar, attached to the structure with an approved duct hanger. Installation shall minimize sharp radius turns or offsets. The maximum length connecting to terminal outlets shall be 7 feet and minimum length of 5 feet.

### 2.3 SINGLE WALL SPIRAL ROUND DUCTS

#### A. Manufacturers:

- 1. McGill Airflow Corporation
- 2. Semco Incorporated

3. Omni Duct
  4. Spiral Mfg. Co., Inc.
  5. Substitutions: Division 01 - Product Requirements.
- B. Product Description: UL 181, Class 1, round spiral lock seam duct constructed of galvanized steel.
1. All ducts over 18 inches in either dimension shall be stiffened with beads on 24 through 20 gage. Cross break on 18 and 16 gauge. Longitudinal seams shall be Pittsburgh locks Snap-Lock shall be limited to 12 inch maximum width of ducts.
- C. Strap hanger shall be a minimum of 1 inch, #18 gauge galvanized steel attached to the bottom of ducts at 8'- 0" OC and as required by CMC/UMC and SMACNA guidelines.
- D. Elbows shall be square throat with vanes, type RE 2 or radius, Type RE 1 in the SMACNA manual. Mitered elbows with turning vanes and other types shall not be used. Construct vanes per Chapter 4 of the SMACNA manual, 3rd edition.
- E. Divided flow branches shall be per SMACNA manual, 3rd edition, figure 4-5.
- F. Branch connections per SMACNA manual, 3rd edition, figure 4-6; 45-degree entry shall only be used where airflow in branch is less than 25% of total airflow in main duct.
- G. Offsets shall be SMACNA manual, 3rd edition, figure 4-7.
- H. Eccentric transitions with maximum 30" divergence shall be used on connections to air handling units and plenums.
- I. Provide Ductmate 25, 35 or 45, per table above, with all required material including metal cleats, corner bolts and nuts, angles, clips and gaskets, all installed in accordance with manufacturer's recommendations and supervision.
- J. Quadrant volume damper blades in fittings shall be two gauges heavier than the fittings.
- K. Longitudinal Seams: Pittsburgh lock sealed with non-curing polymer sealant. Button punch snap lock seams are not acceptable and shall not be used.
- L. Provide drive slip or equivalent flat seams for ducts exposed in the conditioned space or where necessary due to space limitations.
- M. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of non-braced panel area unless ducts are lined.
- N. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- O. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

## 2.4 ROUND DUCT AND FITTING FABRICATION

- A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.
- B. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible."
- C. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible." Fabricate ducts larger than 72 inches in diameter with butt-welded longitudinal seams.
- D. Duct Joints:
  - 1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
  - 2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
  - 3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards-Metal and Flexible," Chapter 3.
  - 4. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.
- E. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA's "HVAC Duct Construction Standards-Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.
- F. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.
- G. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:
  - 1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
  - 2. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.
  - 3. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.
  - 4. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.
  - 5. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction. Fabricate 90 degrees elbows with minimum of 5 pieces.

6. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.
7. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick (20 ga) with 2-piece welded construction.
8. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.
9. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.
10. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch, 26 gage.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

#### 3.2 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, as required in this section.
- B. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Use beaded sleeve couplings for joining round duct and flexible ducts.
- D. Install duct hangers and supports in accordance with approved structural and mechanical drawings.
- E. Use double nuts and lock washers on threaded rod supports.
- F. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.

#### 3.3 INSTALLATION OF METAL DUCTWORK

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3 inch and under; 1% for systems rated over 3 inch) and noiseless (no objectionable noise) systems capable of performing each indicated service. Install each run with a minimum number of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

- B. **Field Fabrication:** Complete fabrication of work at project as necessary to match shop fabricated work and accommodate installation requirements. The fabrication of field dog-leg offsets shall be prohibited.
- C. **Routing:** Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, column, and other structural and permanent enclosure elements of building. Limit clearance to 1/2 inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- D. **Coordination:** Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.
- E. Tape the clips, snaplock seams and joints or connections of the metal supply, return and exhaust ducts and the grilled and diffuser connections with 4 inch strips of 6 oz. canvas attached with approved adhesive. Tape the filter frames the same as ducts. Coat all canvas exposed to the weather with Tuff Bond #12. Taping of Pittsburgh seams is required.
- F. Install access doors to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.
- G. Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.
- H. Round ducts shall be used to the maximum extent possible. As duct size increases, flat oval shall be considered. Rectangular ducts shall be limited to areas of space restriction with a maximum aspect ratio of 2:1. If due to a structural clearance constraint, duct aspect ratio can be increased and/or duct cross section reduced if upstream transition has included angles of 60 degrees or less and downstream transition has included angles of 30 degrees or less.
- I. Ducts exposed outside to elements shall only be of round construction to shed rainwater. If conditions do not allow round ducts, provisions shall be provided to slope the flat top of rectangular ductwork so rainwater will not stand on top of duct.
- J. Except for connection of terminal discharge duct to air outlets, 90 degree taps shall not be used unless space prohibits the use of low loss fittings. Takeoff feeding terminals shall be conical branch; 45 wye, conical branch; low loss tee; bell mouth, or branch with a loss coefficient equivalent to that for the conical branch. The slopes of transitions shall be approximately one to five, and no abrupt changes or offsets of any kind in the duct system shall be permitted.
- K. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.
- L. Install ducts with fewest possible joints.

- M. Install fabricated fittings for changes in directions, size, and shape and for connections.
- N. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- O. Install ducts vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs in ducts that would be over 12 feet in length.
- P. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- Q. Install ducts with a clearance of 2 inch on each side, plus allowance for insulation thickness.
- R. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.
- S. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.
- T. Seal all joints and seams. Apply approved sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- U. Install heavy volume dampers at all main supply, return and exhaust duct branch connections or as indicated on the drawings. Heavy volume dampers shall be Pottorff Series 400 AF with handle, or approved equal.
- V. Duct hangers shall be attached to horizontal slabs with steel angle clips secured with inserts, strapped to vertical walls, bolted to beams and joists, as per SMACNA guidelines, or as approved by the Architect.
- W. All ducts and equipment shall be blown out prior to operating.
- X. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures and telephone equipment rooms.
- Y. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- Z. Install ducts with hangers and braces designed to withstand, without damage to equipment, seismic force required by California building codes.
- AA. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."



BB. Do not paint interiors of metal ducts. Ductwork exposed to view (i.e. Gym) shall have clean finished and sealed joints. Ductwork may be required to be painted per Architect. Coordinate final finish requirements with Architect.

CC. Protect duct openings from damage and prevent entrance of foreign materials.

### 3.4 INSTALLATION OF FLEXIBLE DUCTS

- A. Maximum length: For any duct run using flexible ductwork, do not exceed 5'- 0" extended length.
- B. Installation: Install in accordance with Chapter 3 of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible", latest edition.
- C. Bends in flexible ducts shall have a radius of not less than 1.5 times the internal diameters.

### 3.5 EQUIPMENT CONNECTIONS

- A. General: Connect metal ductwork to equipment as indicated. Provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotary machinery. Provide access doors as indicated.

### 3.6 HANGING AND SUPPORTING

- A. Support horizontal ducts at 8'-0" o.c. and within 24 inches of each elbow and within 48 inches of each branch intersection.
- B. Support vertical ducts at maximum one-story intervals not to exceed 16 feet.
- C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load. Wire and friction clamps shall not be used.

### 3.7 INTERFACE WITH OTHER PRODUCTS

- A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.
- B. Connect diffusers or light troffer boots to low pressure ducts directly or with 5 to 7 feet maximum length of flexible duct held in place with strap or clamp except as otherwise shown on the drawings. Do not use flexible duct on moisture laden air systems.

### 3.8 CLEANING NEW SYSTEM

- A. Division 01 - Execution and Closeout Requirements: Final cleaning.
- B. Mark position of dampers and air-directional mechanical devices before cleaning, and perform cleaning before air balancing.

- C. Use service openings, as required, for physical and mechanical entry and for inspection.
- D. Create other openings to comply with duct standards.
- E. Disconnect flexible ducts as needed for cleaning and inspection.
- F. Remove and reinstall ceiling sections to gain access during the cleaning process.
- G. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
- H. Clean the following metal duct systems by removing surface contaminants and deposits:
  - 1. Air outlets and inlets (registers, grilles, and diffusers).
  - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
  - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
  - 4. Coils and related components.
  - 5. Return-air ducts, dampers, and actuators except in ceiling plenums and mechanical equipment rooms.
  - 6. Supply-air ducts, dampers, actuators, and turning vanes.
- I. Cleaning Requirements:
  - 1. Interior surfaces of all supply ductwork shall be cleaned of dust and dirt at the fabrication shop during fabrication.
  - 2. Supply Ductwork shall be sealed to protect interior surfaces prior to being shipped and handled.
  - 3. Seals and wrapping shall be removed on job site at time of installation.
  - 4. Seal open duct ends during at the end of each day.
- J. Mechanical Cleaning Methodology:
  - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
  - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
  - 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
  - 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet.
  - 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

K. Cleanliness Verification:

1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and re-inspect ducts.

SCHEDULES

L. Static-Pressure Classes: Construct ducts according to the following:

1. Supply Ducts: 2-inch wg.
2. Return Ducts (Negative Pressure): 2-inch wg.
3. General Exhaust Ducts (Negative Pressure): 2-inch wg.
4. Vertical risers shall be constructed to a minimum of 4-inch wg, regardless of type.

END OF SECTION 23 31 00

SECTION 23 33 00 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Volume control dampers.
2. Flexible duct connections.

B. Related Sections:

1. Division 23 - HVAC Ducts and Casings: Requirements for duct construction and pressure classifications.
2. Division 26 - Equipment Wiring Connections: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.2 REFERENCES

A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

B. ASTM International:

1. ASTM E1 - Standard Specification for ASTM Thermometers.

C. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.
2. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems.

D. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible, latest edition.

E. Underwriters Laboratories Inc.:

1. UL 555 - Standard for Safety for Fire Dampers.
2. UL 555C - Standard for Safety for Ceiling Dampers.
3. UL 555S - Standard for Safety for Smoke Dampers.

1.3 SUBMITTALS

A. Division 01 - Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.
- C. Product Data: Submit data for shop fabricated assemblies and hardware used.
- D. Product Data: Submit for the following. Include where applicable electrical characteristics and connection requirements.
  - 1. Backdraft dampers.
  - 2. Flexible duct connections.
  - 3. Volume control dampers.
  - 4. Duct access doors.
  - 5. Duct test holes.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of access doors and test holes.

#### 1.5 QUALITY ASSURANCE

- A. Dampers tested, rated and labeled in accordance with the latest UL requirements.
- B. Damper pressure drop ratings based on tests and procedures performed in accordance with AMCA 500.
- C. Maintain one copy of each document on site.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum three (3) weeks prior to commencing work of this section.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect dampers from damage to operating linkages and blades.
- C. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly indicating manufacturer and material.

- D. Storage: Store materials in a dry area indoor, protected from damage.
- E. Handling: Handle and lift dampers in accordance with manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage.

#### 1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

#### 1.10 COORDINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Coordinate Work where appropriate with building control Work.

#### 1.11 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

#### 1.12 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

### PART 2 - PRODUCTS

#### 2.1 VOLUME CONTROL DAMPERS

- A. Manufacturers:
  - 1. Ventfabrics, Inc.
  - 2. Young Regulator Co.
  - 3. Duro Dyne Corp.
- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
  - 1. Pressure Classes of 3-Inch wg or Higher: End bearings or other seals for ducts with axle's full length of damper blades and bearings at both ends of operating shaft.
- C. Standard Volume Dampers: Multiple-opposed-blade design, standard leakage rating, with linkage outside air stream, and suitable for horizontal or vertical applications. Single blade design may be used for duct sizes 12" and smaller.
  - 1. Steel Frames: Hat-shaped, galvanized (provide stainless in outside air system) sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with

- flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch- thick, galvanized (provide stainless in outside air system) sheet steel.
  3. Blade Axles: Stainless steel.
  4. Bearings: Stainless-steel sleeve.
  5. Tie Bars and Brackets: Galvanized steel.
- D. Jamb Seals: Cambered stainless steel Jack shaft: 1-inch- diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.
- E. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

## 2.2 FLEXIBLE DUCT CONNECTIONS

- A. Manufacturers:
1. Duro Dyne Corp.
  2. Ventfabrics, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.
- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick (24 ga), galvanized sheet steel or 0.032-inch-thick aluminum sheets. Select metal compatible with ducts.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz. /sq. yd.
  2. Tensile Strength: 480 lbf/inch in the warp and 360 lb/inch in the filling.
  3. Service Temperature: Minus 40 to plus 200 deg F.
- E. Outdoor System, Flexible Connector Fabric: Glass fabric insulated double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
1. Minimum Weight: 24 oz. /sq. yd.
  2. Insulation: Fiberglass.
  3. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
  4. Service Temperature: Minus 50 to plus 250 deg F.
- F. High-Temperature System, Flexible Connectors: Glass fabric coated with silicone rubber.

1. Minimum Weight: 16 oz. /sq. yd.
2. Tensile Strength: 285 lbf/inch in the warp and 185 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

G. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.

1. Minimum Weight: 14 oz. /sq. yd.
2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
3. Service Temperature: Minus 67 to plus 500 deg F.

## 2.3 SCREENS

A. Screens shall be 1/4 inch mesh, 12 gauge stainless steel wire set in 1 inch galvanized channel frames for all openings.

## 2.4 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Test holes: Provide in ductwork at fan inlet and outlet, and elsewhere as indicated, duct test holes, consisting of slot and cover, for instrument tests.
2. Quadrant locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 inch. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Manufacturer: Subject to compliance with requirements, provided duct hardware of one of the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.
3. Duro Dyne

## 2.5 ACCESS DOORS

A. Manufacturers:

1. American Warming and Ventilating.
2. Ductmate Industries, Inc.
3. Greenheck.
4. McGill Air Flow Corporation.
5. Ruskin Company
6. Or equal

B. Pressure Relief Access Door: Double wall and duct mounting; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated, latches, and retaining chain.



- C. Frame: Galvanized sheet steel, with bend-over tabs and neoprene gaskets.
- D. Provide negative pressure and positive pressure relief doors design to open automatically to prevent exploding or imploding ductwork in the event dampers close or some other event may occur while the fan is still operating. The door shall automatically close and reset when the pressure is equalized or the system shuts down. Ruskin models PRD18, NRD18 or ADHP-3. Provide insulated doors in supply air systems, stainless steel construction for hazardous air exhaust systems and construction shall be appropriate for the pressure class.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify ducts and equipment installation is ready for accessories.
- C. Check location of air outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

#### 3.2 INSTALLATION.

- A. Install in accordance with NFPA 90A & 90B, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
- B. Provide a volume control damper for each grille and diffuser and in all other locations necessary to properly balance the system.
- C. Quadrants on insulated ducts shall be mounted on sheet metal brackets, set flush with the insulation.
- D. Install the following sizes for duct-mounting, round access doors:
  - 1. 8 inches in diameter for up to 12-inch diameter duct size.
  - 2. 12 inches in diameter for 13-inch to 19 inch duct sizes.
  - 3. 18 inches in diameter for 20-inch to 25 inch duct sizes.
  - 4. 24 inches in diameter for larger duct sizes than listed above.
- E. Install temporary duct test holes required for testing and balancing purposes. Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.
- F. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.
- G. Connect flexible ducts to metal ducts with approved adhesive and draw bands.

- H. Provide instrument test holes in ductwork at fan inlets and outlets and elsewhere as required by Testing, Adjusting and Balancing Contractor for testing and balancing purposes.

END OF SECTION 23 33 00

SECTION 23 34 00 - HVAC FANS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceiling mounted fans.

B. Related Sections:

1. Division 23 - HVAC Insulation: Product requirements for power ventilators for placement by this section.
2. Division 23 - HVAC Ducts and Casings: Product requirements for hangers for placement by this section.
3. Division 23 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.
4. Division 26 - Equipment Wiring Connections: Execution and product requirements for connecting equipment specified by this section.

1.2 REFERENCES

A. American Bearing Manufacturers Association:

1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.

B. Air Movement and Control Association International, Inc.:

1. AMCA 99 - Standards Handbook.
2. AMCA 204 - Balance Quality and Vibration Levels for Fans.
3. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
4. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
5. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

C. National Electrical Manufacturers Association:

1. NEMA MG 1 - Motors and Generators.
2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

D. Underwriters Laboratories Inc.:

1. UL 705 - Power Ventilators.

1.3 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.

- B. Shop Drawings: Indicate size and configuration of fan assembly, mountings, weights, ductwork and accessory connections.
- C. Product Data: Submit data on each type of fan and include accessories, fan curves with specified operating point plotted, power, RPM, sound power levels for both fan inlet and outlet at rated capacity, electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit fan manufacturer's instructions.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.4 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Operation and Maintenance Data: Submit instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

#### 1.5 QUALITY ASSURANCE

- A. Performance Ratings: Conform to AMCA 210 and bear AMCA Certified Rating Seal.
- B. Sound Ratings: AMCA 301, tested to AMCA 300, and bear AMCA Certified Sound Rating Seal.
- C. UL Compliance: UL listed and labeled, designed, manufactured, and tested in accordance with UL 705.
- D. Balance Quality: Conform to AMCA 204.

#### 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three (3) years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three (3) years documented experience.

#### 1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

#### 1.8 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Product storage and handling requirements.
- B. Protect motors, shafts, and bearings from weather and construction dust.

1.9 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two sets of belts for each fan.

PART 2 - PRODUCTS

2.1 CEILING MOUNTED EXHAUST FANS

- A. Manufacturers:
  - 1. Loren Cook Co.
  - 2. Greenheck Fan Corp.
  - 3. ACME Engineering & Manufacturing Corp.
- B. Fan shall be ceiling mounted, direct or belt driven centrifugal cabinet fan with resilient mounted motor and gravity backdraft damper in discharge.
- C. Fan shall bear the AMCA certified ratings seal for sound and air performance.
- D. Centrifugal Fan Unit: Direct driven, forward curved fan wheel with formed galvanized steel housing lined with 1/2 inch acoustic insulation, resilient mounted motor, gravity backdraft damper in discharge, and pre-mounted and wire fan speed controller.
- E. Disconnect Switch: Factory wired, non-fusible, in housing for thermal overload protected motor.
- F. Grille: Aluminum with baked white enamel finish.
- G. Fans shall be equipped with factory adjustable suspension brackets, motor cover and insulated housings.
- H. Motors:
  - 1. All motors shall be open drip-proof with permanently lubricated sealed bearings.
  - 2. Fractional horsepower motors shall be split phase or capacitor start and have a resilient base.
  - 3. Integral horsepower motors shall be induction with rigid base.
  - 4. See equipment schedule for horsepower and characteristics.
- I. Motors shall be selected at 15% greater than the brake horsepower, including drive loss, at design conditions.

- J. Accessories: Shall be as noted on the drawings.

### PART 3 - EXECUTION

#### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as instructed by manufacturer.

#### 3.2 PREPARATION

- A. Furnish roof curbs to roofing contractor for installation.

#### 3.3 INSTALLATION

- A. Secure fans and gravity ventilators with stainless steel lag screws to roof curb or anchor the unit as shown on the drawings.
- B. Fans: Install flexible connections specified in Section 23 33 00 between fan and ductwork. Ensure metal bands of connectors are parallel with minimum one inch flex between ductwork and fan while running.
- C. Install backdraft dampers on inlet to exhaust fans and gravity ventilators used in relief air applications where shown on the drawings and schedules.
- D. Provide backdraft dampers on outlet from cabinet and ceiling fans and as indicated on Drawings.
- E. Install ½" mesh steel safety screen where fan wheel inlet or outlet is exposed.
- F. Provide sheaves required for final air balance.
- G. Solder bottom joints and up 2 inches of side joints of duct under roof ventilator to prevent any moisture from entering ventilator.

#### 3.4 MANUFACTURER'S FIELD SERVICES

- A. Division 01 - Quality Requirements: Requirements for manufacturer's field services.
- B. Furnish services of factory trained representative for minimum of one days to start-up, calibrate controls, and instruct Owner on operation and maintenance.

#### 3.5 CLEANING

- A. Division 01 - Execution and Closeout Requirements: Requirements for cleaning.

- B. Vacuum clean wheels and inside of fan cabinet.

3.6 DEMONSTRATION

- A. Division 01 - Execution and Closeout Requirements: Requirements for demonstration and training.
- B. Demonstrate fan operation and maintenance procedures.

3.7 PROTECTION OF FINISHED WORK

- A. Division 01 - Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Do not operate fans for until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

END OF SECTION 23 34 00

## SECTION 23 37 00 - AIR OUTLETS AND INLETS

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Diffusers.
2. Registers/Grilles.

##### B. Related Sections:

1. Division 09 - Painting and Coating: Execution and product requirements for Painting of ductwork visible behind outlets and inlets specified by this section.
2. Section 23 33 00 - Air Duct Accessories: Volume dampers for inlets and outlets.

#### 1.2 REFERENCES

##### A. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

##### B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets.

##### C. Sheet Metal and Air Conditioning Contractors:

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

#### 1.3 SUBMITTALS

##### A. Division 01 - Submittal Procedures: Submittal procedures.

##### B. Product Data: Submit sizes, finish, and type of mounting. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

##### C. Test Reports: Rating of air outlet and inlet performance.

##### D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

#### 1.4 CLOSEOUT SUBMITTALS

##### A. Division 01 - Execution and Closeout Requirements: Closeout procedures.

##### B. Project Record Documents: Record actual locations of air outlets and inlets.



## 1.5 QUALITY ASSURANCE

- A. Test and rate diffuser, register, and grille performance in accordance with ASHRAE 70 and ADC 1062 "Certification, Rating and Test Manual".
- B. Test and rate louver performance in accordance with AMCA 500.
- C. NFPA Compliance: Install air outlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilation Systems".

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum five (5) years documented experience.

## 1.7 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one (1) week prior to commencing work of this section.

## 1.8 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.

## 1.9 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.

## PART 2 - PRODUCTS

### 2.1 EXHAUST AND RETURN CEILING GRILLES (CR)

- A. Acceptable Manufacturer: Krueger or approved equal.
- B. Material: Aluminum.
- C. Finish: Baked enamel. Coordinate color per Architect.
- D. Face Arrangement: Fixed deflection blades set at 45° and 2/3" o.c.
- E. Frame: 1 1/4" wide
- F. Mounting: Flush surface mounted or T-bar lay-in.

- G. Provide filler panel when installed in 24" X 24" T-bar ceiling. Panel to match ceiling construction. For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to provide 24" x 24" space. Where full 24" x 24" grid module is not available, surface mount the outlet in center cut to fit ceiling tile.

## 2.2 CEILING SUPPLY DIFFUSERS (CD)

- A. Acceptable Manufacturer: Krueger, or approved equal.
- B. Material: Aluminum.
- C. Finish: Baked enamel. Coordinate color per Architect.
- D. Face Arrangement: Fixed louver blades with four (4) removable core modules for adjustable throw pattern.
- E. Pattern: Adjustable from 1-4 way throw.
- F. Mounting: Beveled surface mounted or T-bar lay-in. Verify prior to ordering.
- G. Provide filler panel when installed in 24" X 24" T-bar ceiling. Panel to match ceiling construction. For 24" x 48" T-bar ceilings, coordinate with ceiling installer for auxiliary tees as required to provide 24" x 24" space. Where full 24" x 24" grid module is not available, surface mount the outlet in center cut to fit ceiling tile.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Division 01 - Administrative Requirements: Coordination and project conditions.
- B. Verify inlet and outlet locations.
- C. Verify ceiling and wall systems are ready for installation.

### 3.2 INSTALLATION

- A. Install diffusers to ductwork with airtight connection.
- B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly. Refer to Division 23, Air Duct Accessories.
- C. Paint visible portion of ductwork behind air outlets and inlets matte black. Refer to Division 09.

3.3 INTERFACE WITH OTHER PRODUCTS

- A. Verify final location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

END OF SECTION 23 37 00

## SECTION 23 81 03 - ROOFTOP EVAPORATIVE COOLING

### PART 1 - GENERAL

#### 1.1 SUMMARY

##### A. Section Includes:

1. Packaged A/C units.
2. Roof curb.

##### B. Related Sections:

1. Section 23 31 00 - HVAC Ducts and Casings: Execution requirements for ductwork and duct liner specified by this section.
2. Section 23 33 00 - Air Duct Accessories: Execution requirements for flexible duct connections specified by this section.

#### 1.2 REFERENCES

##### A. Air-Conditioning and Refrigeration Institute:

1. ARI 270 - Sound Rating of Outdoor Unitary Equipment.

##### B. Air Movement and Control Association International, Inc.:

1. AMCA 500 - Test Methods for Louvers, Dampers, and Shutters.

##### C. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 52.1 - Gravimetric and Dust-Spot Procedures for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter.
2. ASHRAE 62 - Ventilation for Acceptable Indoor Air Quality.

##### D. National Fire Protection Association:

1. NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

#### 1.3 SUBMITTALS

##### A. See Section 01 33 00 - Submittal Procedures: Submittal procedures.

##### B. Product Data: Submit data indicating:

1. Dimensions.
2. Weights.
3. Rough-in connections and connection requirements.
4. Duct connections.

5. Electrical requirements with electrical characteristics and connection requirements.
6. Controls.
7. Accessories.

C. Manufacturer's Installation Instructions: Submit assembly, support details, connection requirements, and include start-up instructions.

D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

E. Manufacturer's Field Reports: Submit start-up report.

#### 1.4 CLOSEOUT SUBMITTALS

A. Section 01 70 00 - Execution and Closeout Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of controls installed remotely from units.

C. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, installation instructions, and maintenance and repair data.

#### 1.5 QUALITY ASSURANCE

A. Sound Rating: Measure in accordance with ARI 270.

B. Insulation and adhesives: Meet requirements of NFPA 90A.

C. Perform Work in accordance with State of California standard.

#### 1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01 60 00 - Product Requirements: Product storage and handling requirements.

B. Accept units on site. Inspect for damage.

C. Protect units from damage by storing off roof until roof mounting curbs are in place.

#### 1.7 COORDINATION

A. Coordinate installation of roof curbs with roof structure, roof deck and roof membrane installation.

#### 1.8 WARRANTY

A. Section 01 70 00 - Execution and Closeout Requirements: Product warranties and product bonds.

#### 1.9 EXTRA MATERIALS

A. Section 01 70 00 - Execution and Closeout Requirements: Spare parts and maintenance products.

- B. Furnish one set of media for each unit.

## PART 2 - PRODUCTS

### 2.1 PACKAGE A/C UNITS

- A. Manufacturers:
  - 1. Trane.
- B. General: Unit shall be a fully factory assembled, pre-tested, single-piece evaporative cooling unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start-up. Unit manufacturer shall supply all necessary Belt drives and controls per plans and sequence of operations.
- C. Fans - Supply Air: Supply blower motor shall be Open Drip Proof type with permanently lubricated ball bearings, Class B windings, adjustable sheaves, standard NEMA frame size and service factor. Motor and Blower access through louvered panels. Motors are thermally protected and include heavy duty mounting bracket. Motor shall be activated through a Magnetic Motor Starter. Motors not thermally protected internally shall be protected by IEC overload protection.
- D. Controls and Operating Characteristics: Controls shall be provided as an accessory by unit manufacturer (field installed) .
- E. Electrical Requirements: All unit power wiring shall enter unit cabinet at a single location — side or bottom. All electrical components shall be U.L. listed or recognized. All wire shall be rated to meet or exceed electrical requirements for voltage, ampacity, and dielectric strength of sheathing and temperature rating per location. Minimum temperature rating shall be 105° C. All high voltage wiring shall be enclosed in flexible metallic sheathed BX and include the identifying marker corresponding to the wiring diagram. Unit Control Panel includes 24 volt transformer, line and low voltage terminal blocks, blower motor starter and overload (if motor not thermally protected), fuse block, and relays.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify roof curbs are installed and dimensions are as shown on drawings.

### 3.2 INSTALLATION

#### A. Roof Curb:

1. Install roof curb level per architectural drawings.
2. Coordinate curb installation and flashing with Section 23 05 29.
3. Install units on roof curb providing watertight enclosure to protect ductwork and utility services.
4. Install gasket material between unit base and roof curb.

#### B. Install units on vibration isolator pads.

#### C. Install condensate piping with trap and route from drain pan to condensate drainage system.

#### D. Install components furnished loose for field mounting.

#### E. Install electrical devices furnished loose for field mounting.

#### F. Install control wiring between unit and field installed accessories.

END OF SECTION 23 81 03