

SECTION 23 31 00 – HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Duct materials.
2. Insulated flexible ducts.
3. Single wall spiral round ducts.
4. Ductwork fabrication.
5. Duct cleaning.

B. Related Sections:

1. Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment: Product requirements for hangers, supports and sleeves for placement by this section.
2. Section 23 33 00 - Air Duct Accessories: Product requirements for duct accessories for placement by this section.

1.02 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 A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
4. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
5. ASTM A568/A568M - Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for.
6. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
7. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with

Improved Formability.

8. A1011/A1011M-07 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength.
9. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
10. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
11. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation – Type II, Grade 1, Sheet Materials.
12. ASTM C1534 – Specification for Flexible Polymeric Foam Sheet Insulation Used as Thermal and Sound Absorbing Liner for Duct Systems.
13. ASTM G21/C1338 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
14. ASTM G22 – Standard Practice for Determining Resistance of Plastics to Bacteria.

B. Greenguard Environmental Institute:

1. GEI - Greenguard Certification Standards for Low-Emitting Products.

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.
3. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

D. Sheet Metal and Air Conditioning Contractors:

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

E. Underwriters Laboratories Inc.:

1. UL 94 – Standard for Safety of Flammability of Plastic Materials .

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

F. South Coast Air Quality Management District:

1. SCAQMD Rule 1168 – Adhesive and Sealant Applications, amended January 7, 2005.
 - a. Metal to metal: Maximum VOC content 30 g/L.

G. U.S. Environmental Protection Agency (EPA)

1. EPA-registered antimicrobial agent for HVAC duct lining

1.03 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.

1.04 SUBMITTALS

- A. Section 01 33 00 - 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. Terminal unit, coil and humidifier installations.
 8. Hangers and supports, including methods for building attachment, vibration isolation, and duct attachment.
- C. Product Data: Submit data for duct materials, duct liner and duct connectors.
- D. Duct Pressure Test Form.

1.05 CLOSEOUT SUBMITTALS

- A. Section 01 70 00 - 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.
- C. Duct Pressure Test Report: Indicate pressure tests performed. Include date, section tested, duct design static pressure, test apparatus information (model, fan HP, orifice calibration certificate) test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual, most recent edition.

1.06 SUSTAINABLE DESIGN SUBMITTALS

- A. Manufacturer's Certificate: Certify products meet or exceed specified sustainable design requirements.
 - 1. Materials Resources Certificates:
 - a. Certify recycled material content for recycled content products.
 - b. Certify source for local and regional materials and distance from project site.
 - 2. Indoor Air Quality Certificates:
 - a. Certify volatile organic compound content for each interior adhesive and sealant, related primer and waterproof coating.

1.07 QUALITY ASSURANCE

- A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.
- B. Construct ductwork to NFPA 90A standards and in accordance with applicable mechanical code.

1.08 QUALIFICATIONS

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

1.09 ENVIRONMENTAL REQUIREMENTS

- A. Section 01 60 00 - 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.

PART 2 PRODUCTS

2.01 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 or ASTM A568/A568M.
- C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T6 or of equivalent strength.
- D. Stainless Steel Ducts: ASTM A240/A240M or ASTM A666, Type 316.
- E. Fasteners: Rivets, bolts or sheet metal screws.
- F. Hanger Rod: ASTM A36/A36M; carbon steel or galvanized; threaded both ends, threaded one end, or continuously threaded.
- G. Duct Sealants: Fire-resistive, water-based, indoor/outdoor, U.V.-resistant, non-fibrous sealant for use on low-, medium- and high-velocity duct seams. Foster 32-19; Childers CP-146; Duro Dyne SAS UL.
- H. Adhesive: Water based. Used to adhere duct liner and/or duct Wrap (up to 3#/cu. ft.) to metal. Foster 85-60, Childers CP-127, Duro Dyne SSG

2.02 ACOUSTIC INSULATED FLEXIBLE DUCTS

- A. Manufacturers & Product:
 - 1. Flexmaster – Type 1M
 - 2. Thermaflex – model M-KE
- B. Product Description: UL 181, Class 1, acoustically transparent core, polyethylene liner locked to a helical wound spring steel wire; fiberglass insulation; reinforced, aluminized vapor barrier film.
 - 1. Pressure Rating:
 - a. 10 inches w.g. positive and 1.0 inch w.g. negative through 12-inch diameter.
 - b. 6 inches w.g. positive and 0.5 inch w.g. negative for 14- through 16-inch diameter.
 - c. 4 inches w.g. positive and 0.5 inch w.g. negative for 18- and 20-inch diameter.
 - 2. Maximum Velocity: 5000 fpm.

3. Temperature Range: -20 degrees F to 250 degrees F.
4. Thermal Resistance: 6 square feet-hour-degree F per BTU.

2.03 SINGLE WALL SPIRAL ROUND DUCTS

- A. Product Description: UL 181, Class 1, round or flat oval spiral lockseam duct with light reinforcing corrugations.
- B. Construct round or oval duct in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, most recent edition and as indicated on Drawings. Provide duct material, gauges, reinforcing and sealing for operating pressures indicated.
- C. Fabricate continuously welded round duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.
- D. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.
- E. All elbows 45-degree and 90-degree shall be die-stamped for less than or equal to 10 inches diameter. Elbows greater than 10 inches diameter shall be of the gored type and according to the following: 30-degree shall be 2-gore, 45-degree shall be 3-gore and 90-degree shall be 5-gore.
- F. Seal joints between duct sections and duct seams with mastic adhesive regardless of duct pressure classification.
 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 2. Do not provide sealing products not bearing UL approval markings.
- G. Exposed ductwork to be painted shall have a matte, paint-grip finish.

2.04 RECTANGULAR DUCTWORK FABRICATION

- A. Fabricate and support rectangular ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and [as indicated on Drawings]. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.
- B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation. Provide access door upstream of all turning vanes for inspection and cleaning.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree

lateral wye takeoff, use 90-degree conical tee connections.

- E. Seal joints between duct sections and duct seams with gasket and/or mastic adhesives, regardless of duct pressure classification.
 - 1. Sealants, Mastics and Tapes: Conform to UL 181A. Provide products bearing appropriate UL 181A markings.
 - 2. Do not provide sealing products not bearing UL approval markings.
- F. Offsets shall be radius ogee type where possible. Where space does not allow radius ogee offsets, shop-fabricated mitered offsets with a maximum 30 degree offset angle shall be used.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01 30 00 - Administrative Requirements: Coordination and project conditions.
- B. Verify sizes of equipment connections before fabricating transitions.

3.02 INSTALLATION

- A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.
- B. During construction, install temporary closures of metal or taped polyethylene on all open ductwork, installed or in storage, to prevent construction dust from entering ductwork system.
- C. Duct inlet and outlet areas shall be clean and free of dirt, oil and other bond inhibiting contaminants.
- D. Install duct hangers and supports in accordance with SMACNA Duct Construction Standards.
- E. Use double nuts and lock washers on threaded rod supports.
- F. Connect flexible ducts to metal ducts with nylon draw bands on inner jacket and outer vapor barrier. Finish with mastic adhesive.
- G. Install in accordance with manufacturer's instructions.
- H. Duct sizes are inside clear dimensions.
- I. Located ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- J. Connect terminal units to supply ducts with two inlet size diameters length of straight rigid duct. If run out to box exceeds three feet in length, increase duct size to box inlet as

indicated on detail in Drawings.

- K. All ductwork that is exposed shall be joined with gasketed couplings. For metal to metal joining that cannot be gasketed shall be sealed from the inside. Sealant should not be visible to the end user.
- L. Set plenum doors 6 to 12 inches above floor. Arrange door swing so fan static pressure holds door in closed position.

3.03 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 to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp unless indicated otherwise.
- C. Connect air outlets and inlets to supply ducts with five foot maximum length of flexible duct. If flexible duct is used to change direction, the cross sectional profile of the flexible duct should be maintained.
- D. Where exposed ductwork penetrates a ceiling or wall in finished spaces, install sectional plates or escutcheons to cover the annular opening between pipe and sleeve. Solid plates with set screws shall be used where the sectional plates will not stay in place or are not available in the required size, or where other individual specification section(s) require one piece or greater quality escutcheons or plates. Refer to Section 23 00 01 for additional requirements.

3.04 CLEANING

- A. Section 01 70 00 - Execution and Closeout Requirements: Final cleaning.
- B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to other half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.
- C. Clean duct systems with high power vacuum machines. Protect equipment with potential to be harmed by excessive dirt with filters, or bypass during cleaning. Install access openings into ductwork for cleaning purposes.

3.05 TESTING

- A. For ductwork designed for 3 inches w.c. above ambient per pressure class schedule below, pressure test minimum 25 percent of ductwork after duct cleaning, but before duct insulation is applied or ductwork is concealed.
 - 1. Test in accordance with SMACNA HVAC Air Duct Leakage Test Manual.
 - 2. Maximum Allowable Leakage: In accordance with applicable, local code.

3.06 SCHEDULES

A. Ductwork Material Schedule:

AIR SYSTEM	MATERIAL
Indoor Supply	Galvanized Steel, Aluminum
Indoor Return and Exhaust	Galvanized Steel, Aluminum

B. Ductwork Pressure Class Schedule:

AIR SYSTEM	PRESSURE CLASS
Constant Volume Supply	2 inch w.g.
Variable Air Volume Supply (downstream of VAV boxes)	2 inch w.g.
Variable Air Volume Supply (upstream of VAV boxes)	4 inch w.g.
Return and Exhaust	2 inch w.g.

END OF SECTION