

SECTION 23 3100
HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal ductwork.
- B. Flexible Ducts.
- C. Ductwork Fabrication.

1.02 RELATED REQUIREMENTS

- A. Section 23 0713 - DUCT INSULATION: External insulation and duct liner.
- B. Section 23 3300 - AIR DUCT ACCESSORIES.

1.03 REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2014.
- E. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric); 2011.
- F. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- G. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005.
- H. SMACNA - Duct Cleanliness for New Construction Guidelines., 2000.
- I. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; current edition, including all revisions.

1.04 DEFINITIONS

- A. Low Pressure Duct: Duct having Pressure Class of 2-inches or less.
- B. Medium or High pressure Duct: Duct having Pressure Class over 2-inches.

1.05 SUBMITTALS

- A. Refer to Section 23 0510 - General HVAC Requirements for submittal procedures.
- B. Product Data: Provide data for :
 - 1. Duct take-off fittings.
 - 2. Manufactured metal ductwork and fittings.
 - 3. Flexible ducts.
 - 4. Transverse Duct Connection System.
- C. Shop Drawings: Refer to Section 23 0510 for duct shop drawing requirements.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience, and approved by manufacturer.
- B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.07 FIELD CONDITIONS

- A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

- B. Maintain temperatures within acceptable range during and after installation of duct sealants.

1.08 DELIVERY, STORAGE, AND PROTECTION(REFER TO DUCT CLEANLINESS LEVEL SPECIFIED IN INSTALLATION)

- A. Store in clean dry place and protect from weather and construction traffic.
- B. Exercise care during construction to prevent the accumulation of dust, dirt, and refuse in the supply and return ductwork.
- C. All openings shall be tightly closed with 8-mil polyethylene when work creating dust and debris is in progress.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.
- B. Provide Paint-Grip finish on exposed galvanized ducts for field painting.
- C. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content: Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics: Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
 - 4. Manufacturers:
 - a. Manufacturers (water based): Ductmate Proseal, Hardcast IronGrip 601, Marathon 460, Foster 32-19; Childers CP-146, DuroDyne SAS.
- D. Hanger Rod: ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

2.02 DUCTWORK FABRICATION

- A. General:
 - 1. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. No variation of duct configuration or size permitted except by written permission. Size round duct installed in place of rectangular ducts in accordance with ASHRAE Handbook - Fundamentals.
- C. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- D. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows must be used, provide air foil turning vanes of perforated metal with glass fiber insulation.
- E. Provide turning vanes of perforated metal with glass fiber insulation when acoustical lining is indicated.
- F. All dimensions are net inside metal measurements in inches unless otherwise shown.
- G. Duct sizes shown include allowance for liner thickness unless otherwise noted, except sizes shown for lined round spiral and flat oval duct are sizes of perforated inner liner
- H. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
- I. Low Pressure Duct- Supply, Return, and Exhaust (2" Class or less):
 - 1. Longitudinal Seams:
 - a. Corner Seams: Fig. 2-2, Type L1 (Pittsburgh Lock).
 - 1) Corner seams for ducts less than 18 inch, L-2 (Button Punch Snap Lock) is acceptable.

- b. Fig. 2-2, Type L-3 for seams other than corner.
2. Transitions:
 - a. Changes in duct sizes shall be made by transitions.
 - b. Refer to Fig. 4-7, CONCENTRIC TRANSITION, unless otherwise noted.
 - 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. Transitions shall be provided between equipment and duct where sizes are not the same.
3. Rectangular Duct:
 - a. Elbows:
 - 1) Mitered with turning vanes. Type RE 2, Figure 4-2, unless otherwise noted.
 - b. Turning Vanes:
 - 1) Turning vanes shall be in accordance with Figs 4-3 and 4-4, unless otherwise noted.
 - 2) Provide single wall vanes for ducts 18" width or less.
 - 3) Provide double wall vanes for ducts over 18" width.
 - c. Splits and Tees:
 - 1) Fig. 4-5, Type 1, Type 2 (with stationary splitter), 4A, or 4B only.
 - 2) Use of Square Throat Elbow with Turning Vanes is acceptable, unless otherwise noted.
 - (a) Provide volume control damper in each branch.
 - 3) Omit volume control damper in Return and Exhaust duct unless otherwise noted.
 - d. Where acoustical lining is indicated, provide acoustical turning vanes of perforated metal with glass fiber insulation.
4. Round Duct - Manufactured Spiral Duct:
 - a. Elbows: Radius elbow with radius not less than 1-1/2 times width of duct on centerline.
5. Branch and Runout Connections:
 - a. Entry fittings for Return and Exhaust: Construct for a 45 degree entry angle to ease the turbulence created by converging airstreams. Increase the minimum length shown in Fig. 4-6, 45 DEGREE ENTRY, from 4 inch to 6 inch.
 - b. Rectangular Branch or Runout from Rectangular Duct:
 - 1) Fig. 4-6, 45 DEGREE ENTRY, with flange and gasket for connection to trunk with a minimum of six screws.
 - c. Round Branch or Runout from Rectangular Duct:
 - 1) Fig. 4-6, 45 DEGREE LEAD IN, with flange and gasket for connection to trunk with a minimum of six screws.
 - 2) Provide volume control damper with locking quadrant at branch or runout connection.
 - d. Round Branch or Runout from Round Duct:
 - 1) Fig. 3-5, 90 DEGREE tee fitting with 45 DEGREE oval to round tap, unless otherwise noted.
 - 2) Fig. 3-6, CONICAL TEE fitting.
 - e. Rectangular Runout to Sidewall Grille/Register:
 - 1) Fig. 4-6, 45 DEGREE ENTRY, with flange and gasket for connection to trunk with a minimum of six screws.
6. Offsets: Fig. 4-7, Type 1 and Type 3 only, unless otherwise indicated.
7. Gooseneck Roof Discharge: Fig. 6-5 with roof curb.
8. Dampers: Fig. 7-4, SINGLE BLADE TYPE, or 7-5, MULTIBLADE TYPE.
9. Reinforcement:
 - a. Fabricate ducts in clearance critical areas such as chases and above ceilings to unreinforced standards, Fig. 2-8.

- 1) Tie Rod Reinforcement is acceptable in Supply, Return, and Exhaust duct only.
 - 2) No screw or rivets are allowed to penetrate ducts.
- J. Medium Pressure Rectangular and Round Duct- Supply (Higher Than 2" Pressure Class):
1. Provide Shop Fabricated Ductwork.
 2. Transitions:
 - a. Changes in duct sizes shall be made by transition fittings.
 - b. Refer to Fig. 4-7, CONCENTRIC TRANSITION, unless otherwise noted.
 - 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. Transitions shall be provided between equipment and duct where sizes are not the same.
 3. Rectangular Duct:
 - a. Longitudinal Seams:
 - 1) Corner Seams: Fig. 2-2, Type L1 (Pittsburgh Lock).
 - (a) Corner seams for ducts less than 18 inch, L-2 (Button Punch Snap Lock) is acceptable.
 - 2) Fig. 2-2, Type L-3 for seams other than corner.
 - b. Elbows:
 - 1) Radius Type RE 1, Figure 4-2 with radius not less than 1-1/2 times width of duct on centerline.
 - 2) Where rectangular elbows are indicated on the drawings, construct in accordance with Figure 4-2, Type RE 2 (mitered w/vanes).
 - c. Turning Vanes:
 - 1) Turning vanes shall be in accordance with Figs 4-3 and 4-4, unless otherwise noted.
 - 2) Provide single wall vanes for ducts 18" width or less.
 - 3) Provide double wall vanes for ducts over 18" width.
 - d. Tees and Splits:
 - 1) Fig. 4-5, Type 1, 4A, or 4B only. Radius elbows only, unless otherwise noted.
 - e. Where acoustical lining is indicated, provide acoustical turning vanes of perforated metal with glass fiber insulation.
 4. Round Duct - Manufactured Spiral Duct
 - a. Elbows: Radius with radius not less than 1-1/2 times width of duct on centerline, unless otherwise noted.
 5. Branch and Runout Connections:
 - a. Entry fittings for Return and Exhaust: Construct for a 45 degree entry angle to ease the turbulence created by converging airstreams. Increase the minimum length shown in Fig. 4-6, 45 DEGREE ENTRY, from 4 inch to 6 inch.
 - b. Rectangular Branch or Runout from Rectangular Duct:
 - 1) Fig. 4-6, 45 DEGREE ENTRY, with flange and gasket for connection to trunk with a minimum of six screws.
 - c. Round Branch or Runout from Rectangular Duct:
 - 1) Fig. 4-6, 45 DEGREE LEAD IN, with flange and gasket for connection to trunk with a minimum of six screws.
 - d. Round or Flat Oval Branch or Runout from Round or Flat Oval Duct:
 - 1) Fig. 3-6, CONICAL FITTING, unless otherwise noted.
 - 2) Fig. 3-6, CONICAL TAP is acceptable only where noted on drawings.
 - 3) Fig. 3-6, CONICAL TEE AND REDUCER FITTING.
 - 4) Fig. 3-5, 45 DEGREE LATERAL FITTING.
 - 5) Refer to drawings for indication of whether the fitting is lateral or 90 degree angle.
 - e. Rectangular Branch or Runout from Round Duct:

- 1) Fig. 4-6, 45 DEGREE ENTRY, with flange and gasket for connection to trunk with a minimum of six screws.
6. Offsets: Fig. 4-7.
7. Bellmouths: Fig. 4-7.
8. Pressure Relief/Access Door:
 - a. Fig. 7-3, COMBINATION ACCESS AND PRESSURE RELIEF.
 - b. Provide downstream of all fire dampers and where indicated on drawings.
9. Reinforcement:
 - a. Fabricate ducts in clearance critical areas such as chases and above ceilings to unreinforced standards, Fig. 2-8.
 - b. Tie Rod Reinforcement is acceptable in Rectangular Supply duct only.
 - c. No screw or rivets are allowed to penetrate ducts.
- K. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).
- L. Ducts Connecting to Wall Louvers:
 1. Provide sheet metal plenum sealing louver area and connecting duct.
 2. Fabricate in accordance with Fig. 6-1.
 3. Fabricate plenum using same material and pressure class as connecting duct.
 4. Paint exterior side of plenum flat black.
- M. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.03 MANUFACTURED DUCTWORK AND FITTINGS

- A. Manufacture in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. Round Ducts: Machine made from round spiral lockseam duct.
 1. Manufacture in accordance with SMACNA (DCS).
 2. Machine made from round spiral lockseam duct with light reinforcing corrugations and factory slip fit joints; fittings manufactured of at least two gages heavier metal than duct.
 3. Fittings: Seams shall be fully welded. Tack welding and sealing is not acceptable.
 4. Take-offs: Take-offs to terminal units, etc. shall be tee fittings, except;
 - a. duct manufactured by McKenney's, Inc. may be saddle-tap connections, installed by cutting hole and field welded tap to straight section of duct and sealed.
 5. Transformations: Transformations shall comply with lengths indicated in United Metal (McGill Airflow catalogs (maximum of 24" long)
 6. Provide relief type access panels (RAP) downstream of all fire dampers and where indicated on drawings
 7. Fittings: Manufacture at least two gages heavier metal than duct.
 8. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
 9. Manufacturer-Layout Basis: United McGill Corporation.
 - a. Other Acceptable manufacturers:
 - 1) BH&W Sheetmetal (Atlanta)
 - 2) Dixie Sheet Metal Products.
 - 3) Don Park, Inc.
 - 4) Eastern Sheet Metal.
 - 5) Hamlin Sheet Metal Company.
 - 6) Impulse Air.
 - 7) Lindab, Inc.
 - 8) McKenney's, Inc. (Atlanta)
 - 9) Monroe Metals.
 - 10) RF Knox.
 - 11) Semco.

- 12) South Spiral Pipe, Inc.
- C. Flexible Ducts: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
 2. Insulation thickness shall be 1 inch thick, minimum; 3/4 lbs./cu ft, minimum.
 3. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
 4. Maximum Velocity: 4000 fpm.
 5. Temperature Range: Minus 20 degrees F to 210 degrees F.
 6. Manufacturers:
 - a. Atco Rubber Products, Inc; Model UPC-037: www.atcoflex.com.
 - b. Flexible Technologies Group-Thermafex, Inc; Model M-KE: www.thermafex.net
 - c. Flexmaster USA; Model Type 3M: www.flexmasterusa.com.
 - d. Wiremold, Inc; Model WK: www.wiremold.com.
- D. Transverse Duct Connection System: SMACNA "E" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips in accordance with SMACNA (DCS).

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- C. Duct sizes for lined duct are net metal and include allowance for liner. For unlined duct, sizes are inside clear dimensions.
- D. Duct sizes for runouts to grilles, registers and diffusers shall match the size of the device unless otherwise noted.
- E. Duct Cleanliness level: Advanced Level in accordance with SMACNA Duct Cleanliness for New Construction Guidelines.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- G. Use double nuts and lock washers on threaded rod supports.
- H. Seal all transverse and longitudinal joints in all metal supply, exhaust and return ducts.
- I. Supply duct run-out to inlet of terminal unit shall be the same size as the terminal unit connection unless indicated otherwise on the Drawings.
- J. Connect terminal units to supply ducts directly.
- K. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.02 SCHEDULES

- A. Ductwork Material:
 1. Low Pressure Supply Concealed: Galvanized Steel.
 2. Medium Pressure Supply Concealed: Galvanized Steel.
 3. General and General Laboratory Exhaust: Galvanized Steel.
- B. Ductwork Pressure Class:
 1. Supply System downstream of Air Terminal Units: 2 inch.
 2. Supply System upstream of Air Terminal Units: 6 inch (medium pressure).
 3. General Laboratory Exhaust: 2 inch negative.
 4. Mixing Plenums and Transfer Ducts: 2 inch.

END OF SECTION