

SECTION 23 31 13

DUCTWORK AND SHEET METAL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

- A. The requirements of the General Conditions, Supplementary Conditions, Division 1, Division 20, and Drawings apply to all Work herein.
- B. Requirements of the following Division 20-28 Sections apply to this section:
 - 1. Scope of Work - Section 23 05 01
 - 2. Design Criteria - Section 23 05 02
 - 3. Basic Division 20-28 Requirements - Section 20 05 03
 - 4. Schedule of Submittal Data - Section 23 05 04
 - 5. General Division 20-28 Materials and Methods - Section 20 05 05
 - 6. Start-up, Testing, Adjusting, and Balancing - Section 23 05 93

1.01 SCOPE

- A. General: Furnish and install all round and rectangular ductwork, flexible duct, hangers, supports, sleeves, flashings, vent flues and all necessary accessories as shown on the Drawings and as specified herein.
- B. Related Sections: Other Division 20-28 Sections contain requirements related to the work of this Section. These may include, but not be limited to, the following sections:
 - 1. Thermal Insulation - Section 20 07 00
 - 2. Air Terminal Units - Section 23 36 00
 - 3. Sound Attenuators - Section 23 33 19
 - 4. Air Distribution Devices and Dampers - Section 23 33 10
 - 5. Air Filtering - Section 23 41 10

1.02 QUALITY ASSURANCE

A. CODES AND STANDARDS

- 1. Ductwork shall be constructed in accordance with construction requirements specified in the 1995 SMACNA Edition of "HVAC Duct Construction Standards", except where SMACNA requirements are exceeded in these specifications.
- 2. Kitchen hood and dishwasher hood exhaust ductwork - NFPA 96.
- 3. Laboratory hood and chemical fume exhaust ductwork - NFPA 45.

PART 2 - PRODUCTS

2.01 SYSTEM REQUIREMENTS

A. System Class:

- 1. All Ductwork upstream of air terminal units shall be constructed for static pressure class based on scheduled external static pressure from applicable air handling unit schedule. Material shall be 2500 FPM Class galvanized steel of "lock forming" quality unless otherwise noted.

2. All ductwork downstream of air terminal units, Multizone supply ductwork, and single zone air handling unit supply ductwork shall be built to +1" W.G., 2500 FPM Class Standards, unless noted otherwise on fan schedule. All +1" Class ductwork shall be constructed of "lock forming quality" galvanized sheet metal with a minimum gauge not less than that shown in SMACNA Standards.
3. All return and exhaust ductwork shall be built to -2" W.G., 2500 FPM Class Standards, unless noted otherwise on fan schedule.

2.02 GENERAL CONSTRUCTION

- A. All ductwork shall be constructed of G60 coated galvanized steel of ASTM Standards A653 and A924 grades.
- B. Minimum gauge of any ductwork, round or rectangular, shall be 26 gauge.
- C. The interior surface of all ductwork shall be smooth with no sheet metal or other parts projecting into the air stream. All seams and joints shall be external. The inside of all ductwork shall be thoroughly cleaned and all fans operated to remove any debris prior to connection of air distribution devices.
- D. All ductwork dimensions on the Drawings are clear inside dimensions. Refer to Section 20 07 00 for ductwork liner and insulation.
- E. All flexible round take-offs to Air Distribution Devices shall be made with a spin-collar with integral manual volume damper. Spin-ins shall be installed with their damper axis parallel to air flow.
- F. Ductwork Leakage: Maximum allowable ductwork leakage, as a percentage of air system volume, shall be 2%.
- G. Ductwork Sealing:
 1. All transverse duct joints, longitudinal seams and duct wall penetrations shall be sealed regardless of duct pressure classification.
 2. Sealer shall be rated by manufacturer and shall be suitable for use at the system static pressure classification of the ductwork applied.
 3. Ductwork sealant shall be Hardcast "Versa-Grip 181" or approved equal. Sealant shall be suitable for use indoors and outdoors. Sealant shall be water based. Sealant shall have a flame spread rating of 25 or less and a smoke developed rating of 50 or less. Sealant shall be listed in accordance with UL 181A or UL 181B, as required in the International Energy Conservation Code.
 4. Duct sealant shall be applied per manufacturer's instructions. Minimum drying time shall be allowed per manufacturer's instructions. Additional time for drying shall be allowed in climates where temperature and humidity may affect the curing of the sealant. Sealant shall be allowed to completely dry and harden before air is circulated through the ductwork.
 5. The use of duct tape for sealing of metal ducts is prohibited unless the tape is part of, and used, in conjunction with a multi-part sealing system (i.e., adhesive, tape, coating, etc.).

2.03 RECTANGULAR DUCTWORK

- A. Transverse Bead: Transverse bead all flat surfaces which are more than 12" wide. Transverse beading shall be on 12" centers and shall be minimum of 1/8" deep at the center of the bead and 3/8" wide at the base of the bead. **Do Not** cross-break negative pressure ductwork.

- B. Longitudinal Seams: All longitudinal seams shall be "Pittsburgh Lock" or Button Punch Snap Lock at corner seams and Grooved (ACME) Seam or Seam Welded in sides between corners.
- C. Transverse Joints: All transverse joints and intermediate reinforcement shall be as shown in SMACNA Tables 1-4 through 1-9, and Figure 1-4 with Drive Slip connections (reinforced or un-reinforced as required) on the short sides and hemmed "S" slip connections (reinforced or un-reinforced as required) on the long sides. "S" and drive connectors are acceptable for use on ducts with pressure classification of ± 1 " w.g. (maximum). At the Contractor's option, transverse joints may be transverse duct connectors by one of the following manufacturers. The proposed gasket material, flange, corner piece, and connection details shall be submitted for review.
1. Transverse Duct Flange (TDF or TDC)
 2. Ductmate EP12/11 prefabricated galvanized "Ductmate" sections
 3. MEZ Industries 140 Series transverse duct connectors
 4. Exanno (Nexus)
 5. Ward Industries, Inc.
- D. Plenums: Sheet metal plenums shall be constructed and reinforced in accordance with SMACNA Standards. Where plenums are connected to louvers, the Plenum bottom shall be watertight, sloped and sealed to drain water to the outside face of the building through the face of the louver.
- E. Support: All ductwork supports shall be per Table 4-1 of the SMACNA manual with all supports directly anchored to the building structure. Supports shall be on maximum 8'- 0" centers with additional supports as required to prevent sagging.
- F. Fabric Connections: Flexible duct fabric connections shall be installed on the inlet and outlet connections to all powered air moving equipment not connected with flexible duct attached directly to inlet or discharge plenum. A minimum of 1" of slack shall be allowed in all flexible connections to insure vibration isolation. Flexible fabric shall be a minimum of 3 inches wide with "Grip-Loc" seam to 24 gauge galvanized metal side connectors a minimum of 3 inches wide each. Flexible connections are to be fabricated with Duro Dyne Excelon "Metal-Fab" vinyl coated 22 oz. nylon with 24 gauge galvanized iron side connectors or "approved equal".
- G. Splitter Dampers: Install manual splitter dampers in splits and branch take-offs in all constant volume air flow systems, and where shown on Drawings. Splitter dampers shall be minimum 16 gauge galvanized sheet metal and shall be 3/4 of the width of the smallest take-off but no less than 6" long. Dampers shall have 1/8" of clearance to the duct in which they are installed. Splitter dampers shall be controlled by one or more control rods. Where splitters are in concealed inaccessible locations, submit proposed control rod details for approval.
- H. Transitions: Ductwork transitions and offsets shall be constructed in accordance with Fig. 2-7 of the SMACNA manual.
- I. Branch Taps: Branch taps, including taps to terminal units, shall be 45° entry expanded taps and shall be in accordance with Fig. 2-6 of the SMACNA manual. Taps to terminal units may be Flexmaster STO side takeoff fittings. Dovetail joints on round taps are not permitted.
- J. Turning Vanes: Turning vanes shall be installed where shown on the Drawings and in all abrupt elbows and bends greater than 45°. For ducts less than 12" in height, single vane

blades may be installed. For ducts 12" high and above, double airfoil blades shall be used. Turning vanes shall be constructed in accordance with Figures 2-3 and 2-4 of the SMACNA manual.

- K. Radius Elbows: Radius elbows shall be used where shown on the Drawings and may be used for all 45° and 90° elbows if they fit in the available space, and all elbows 12" and smaller. Radius elbows shall be constructed in accordance with Figure 2-2 of the SMACNA manual.
- L. Weather Exposed: Ductwork that is exposed to weather shall have soldered seams and shall be painted with a suitable epoxy coating. Sections shall be joined using Ductmate or TDF joining method, no substitutes.

2.04 LOW VELOCITY ROUND DUCTWORK (BRANCH RUN-OUTS)

- A. Rigid round low pressure, low velocity ductwork material, gauge, transverse joints and longitudinal seams shall be in accordance with SMACNA Standards, with the following exceptions:
 - 1. Draw band transverse joints are not acceptable.
 - 2. Minimum duct/fitting gauge shall be 26 gauge.
 - 3. "Adjustable" elbows and fittings are not acceptable.
 - 4. All longitudinal seams shall be "Groovelock".

2.05 FLEXIBLE DUCTWORK

- A. General: Flexible duct shall be used where flexible duct connections are shown on the Drawings to air distribution devices and terminal units. Maximum length shall be 4'-0" for terminal units and 8'-0" for air distribution device connections. Where longer runs are required, provide rigid round ductwork.
- B. Flexible Duct:
 - 1. Insulated flexible duct shall be a factory-fabricated assembly consisting of a galvanized steel or spiral aluminum helix.
 - 2. Inner liner shall be a smooth, airtight CPE film.
 - 3. Insulation shall be fiberglass with a maximum thermal conductance of 0.167 BTUH/HR/SF/°F at 75°F mean temperature (R Value = 6).
 - 4. The assembly shall be sheathed in a reinforced metalized Mylar vapor barrier outer jacket with permeance not exceeding 0.17 perms/sf at 1" pressure.
- C. Standards: The flexible duct assembly shall be suitable for a minimum working pressure of +6" w.g. and -4" w.g., and shall be listed Class I Air Duct by the Underwriters Laboratory (UL-181) at a flame spread of not over 25 and a smoke developed rate of not over 50. Ducts shall also comply with NFPA Standard 90A.
- D. Connections: All joints and connections shall be made with 1/2" wide stainless steel duct clamps or 100% nylon self-locking clamps. Refer to Details on Drawings.
- E. Installation: Flexible ducts shall be supported in such a manner to prevent sags and kinks. Bends in any length of flexible duct shall not exceed a total turning of 90°. Extend insulation and outer jacket over the secured clamp and tape down to the sleeve/collar to maintain vapor barrier integrity. "R-value" of 6 must be maintained through installation. Insulation on flexible duct shall not be compressed.

- F. Manufacturers: If it complies with these Specifications, flexible ductwork of the following types will be acceptable:
1. Flexmaster Type 8M
 2. Thermaflex M-KE

2.06 ACCESS DOORS

- A. Provide Flexmaster "The Inspector Series" - Spin Door for Field Fabrication and Tab Door for Shop Fabrication, or approved equal dual wall, insulated, access doors in ductwork as required for access to fire, smoke and fire/smoke dampers, duct smoke detectors, sampling tubes, humidifiers and other duct mounted devices. Door size shall not be less than 2" in diameter smaller than the depth of the duct in which it is to be installed.

2.07 PROVISIONS FOR LOUVERS

- A. Louvers with 1/2" mesh birdscreen shall be furnished and installed by the General Contractor under another Division. This division shall furnish motorized or gravity control dampers, insulated sheet metal plenums, and duct connections to louvers as required, and where shown on the Drawings. All unused portions of louvers shall be blanked off with 18 gauge galvanized sheet metal and insulated with 1-1/2" rigid fiberglass board insulation.

2.08 PARTITION PENETRATION SLEEVES

- A. Provide 22 gauge sheet metal sleeves in all non-ducted air path partition penetrations shown on the Drawings where return air boots (RAB), combination fire and smoke dampers (FSD), fire dampers (FD), etc., are **not** provided. Coordinate location and size of all partition penetration sleeves with the partition Contractor. Sleeves shall be fabricated with 1/2" flanges, turned out on one end. Sleeves shall extend through wall on both sides.

2.09 MEDIUM PRESSURE SPIRAL SEAM DUCTWORK

- A. Medium pressure duct shall be round spiral seam sheet metal constructed as specified herein and in accordance with the Second Edition (1995) of SMACNA "HVAC Duct Construction Standards".
- B. Duct and fittings shall be manufactured from galvanized sheet metal outlined in Section 2.02, Paragraph A. All fittings shall be factory fabricated, machine formed and welded from galvanized sheet metal with built-in couplings. The minimum gauge of duct and fittings shall be 26 gauge.
- C. Spiral duct and fittings joints shall be assembled, suspended, sealed, and taped per manufacturer's published assembly and installation instructions. Horizontal and vertical ductwork supports shall be as recommended by the duct manufacturer and shall not have any screws through the ductwork.
- D. Duct cements for use at couplings shall be United Sheet Metal Uni-Weld metal cement or an approved substitute and shall be used per the manufacturers recommendations. Duct sealer shall be the United Sheet Metal Uni-Cast System, or an approved substitute utilizing an adhesive, tape and coating to obtain a complete duct seal.
- E. Provide standard 90-degree conical fittings connections for branch takeoffs.

- F. Manufacturers: If they comply with these specifications and requirements, products of the following manufacturers will be acceptable:
1. United McGill
 2. Gowco, Inc.
 3. GRACO
 4. TD Mechanical

PART 3 - EXECUTION

3.01 SUBMITTAL

- A. Ductwork shop drawings shall be made after job site measurements are made and shall be coordinated with all other trades. Ductwork construction details and materials shall be submitted and approved prior to fabrication of any ductwork. Ductwork submittal shall include ductwork fabrication drawings and submittal data on ductwork specialties and construction details.
- B. Ductwork fabrication drawings shall be drawn to scale on 1/8" or larger scale building floor plans and shall indicate duct sizes, duct material, duct insulation type, locations of transverse joints, fittings, ductwork bottom elevation, offsets, ductwork specialties, fire and fire/smoke dampers and all other information required for coordination with other trades and fabrication of ductwork. All fire and fire/smoke partitions shall be clearly designated on the ductwork shop drawings. Detail drawings for mechanical rooms and air handling unit locations shall be drawn to 1/4" scale.
- C. Duct fabrication drawings shall be coordinated with other trades and building construction prior to submittal for approval, and shop drawings shall be so certified on each drawing.

3.02 INSTALLATION

- A. Install all ductwork tight to structure unless otherwise noted. The Mechanical Contractor shall coordinate with all other trades prior to the construction or installation of ductwork.
- B. Install duct mounted sensors and control devices furnished under Section 23 09 16. Furnish and install access doors at each duct mounted control device. Coordinate location of devices and installation requirements with the Automatic Temperature Control Subcontractor.
- C. Install duct type smoke detectors furnished under Division 28. Furnish and install access doors at each sampling tube assembly. Coordinate location of detectors and installation requirements with the Electrical Subcontractor.
- D. Furnish and install access doors at all fire dampers, smoke dampers, and combination fire/smoke dampers.
- E. Ductwork shall be thoroughly cleaned, or verified as clean prior to fan startup. Reference Section 20 05 05 for related issues.

3.03 LEAK TESTING

- A. Ductwork constructed to operate at +2" w.g. or greater or -2" w.g. or less shall be leak tested in accordance with the following:
1. Contractor shall test duct for leakage in accordance with the "System Pressure Testing for Leaks" publication by United McGill Corporation apparatus used for

- testing shall be as noted in referenced publication. Deviations from this shall not be permitted.
2. Duct systems shall be pressurized to 125% of rated system pressure classification as described in Subsection 2.01 of this Section.
 3. Maximum allowable leakage shall be in accordance with Subsection 2.02 of this Section.
- B. Ductwork constructed to operate at pressures between -2" w.g. and +2" w.g. shall be visually inspected for leakage.
1. Engineer may request ductwork leakage test, in accordance with Paragraph A. of this Subsection, if in his opinion, testing is warranted due to installation of duct systems or information contained in test and balance report.
- C. Ductwork leak testing and/or inspection shall be performed prior to installation of external ductwork insulation.
- D. If requested by the Engineer, Contractor shall schedule duct leakage testing and/or inspection so that it may be witnessed by Engineer.

END OF SECTION