

## SECTION 15800 - HVAC SHEET METAL

## PART 1 – GENERAL

## 1.01 SCOPE

- A. All low pressure duct work (1" SPWG Class Construction or as indicated on the drawings) including supply, return, exhaust, and outside air ductwork, and other special ducting, flues, vents, or chimneys to complete the systems as shown on the drawings or specified herein.

## 1.02 DEFINITIONS

- A. Diffusers: Circular, square, or rectangular air distribution outlet, generally located in the ceiling and comprised of deflecting members discharging supply air in various directions and planes and arranged to promote mixing of primary air with secondary room air.
- B. Grille: A louvered or perforated covering for an opening in an air passage, which can be located in a sidewall, ceiling or floor.
- C. Register: A combination grille and damper assembly over an air opening.

## 1.03 SUBMITTALS

- A. Submit the following:
  - 1. Air distribution devices and accessories, including louvers.
  - 2. Smoke and Fire dampers and doors.
  - 3. Flexible duct.
  - 4. Flexible connections.
  - 5. Damper hardware.
  - 6. Multi-blade dampers.
  - 7. Access doors.
  - 8. Turning vanes.
  - 9. Duct Liner.
- B. Product Data: For each model indicated, include the following:
  - 1. Data Sheet: For each type of air outlet and inlet, and accessory furnished: indicate construction, finish, and mounting details.
  - 2. Performance Data: Include throw and drop, static-pressure drop, and noise ratings for each type of air outlet and inlet.
  - 3. Schedule of diffusers, registers, and grilles indicating drawing designation, room location, quantity, model number, size, and accessories furnished.
  - 4. Assembly Drawing: For each type of air outlet and inlet; indicate materials and methods of assembly of components.
- C. Coordination Drawings: Provide reflected ceiling plans and wall elevations drawn to scale to show locations and coordination of diffusers, registers, and grilles with other work installed in ceilings and walls and submit for approval. See Section 15000, Par. 1.04 for other requirements.
- D. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available for diffusers, registers, grilles, and louvers with factory-applied color finishes when requested.
- E. Samples for Verification: Of Diffusers, registers, grilles, and louvers in manufacturer's

standard sizes, showing the full range of colors when requested. Prepare Samples from the same material to be used for the work.

#### 1.04 REFERENCES

- A. ASHRAE – Handbook 2001 Fundamentals; Chapter 35 – Duct Design.
- B. ASHRAE – Handbook 2000 HVAC Systems and Equipment; Chapter 16 – Duct Construction.
- C. ASTM A 90 – Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
- D. ASTM A 167 – Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
- E. ASTM A 525 – General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.
- F. ASTM A 527 – Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.
- G. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
- H. NFPA 91 Exhaust Systems
- I. NFPA 92A and 92B – Smoke Control and Smoke Management
- J. NFPA 96 – Commercial Cooking Operations.
- K. SMACNA – HVAC Duct Construction Standards
- L. UL 181 – Factory-Made Air Ducts and Connectors.
- M. NAIMA (North American Insulation Manufacturers Association) Air Duct Cleaning.
- N. NADCA (National Air Duct Cleaner Association) – Air Duct Cleaning.

#### 1.05 GOVERNING PUBLICATIONS AND AUTHORITIES

- A. ASHRAE Handbooks.
- B. SMACNA Standards.
- C. Underwriters Laboratories, Inc.
- D. NFPA Pamphlets
- E. NAIMA
- F. NADCA

## PART 2 – PRODUCTS

### 2.01 MATERIALS

- A. General: Non-combustible or conforming to requirements for Class 1 air duct materials, or UL 181.
- B. Steel Ducts: ASTM A525 or ASTM A527 galvanized steel sheet, lock-forming quality, having zinc coating of 1.25 oz per sq.ft. for each side in conformance with ASTM A90.
- C. Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.
- D. Hanger Rod: Steel, galvanized; threaded both ends, threaded one end, or continuously threaded.

#### 2.02 LOW PRESSURE DUCT WORK

- A. Fabricate and support in accordance with SMACNA Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- B. 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 are used, provide air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
- D. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.
- E. Use double nuts and lock washers on threaded rod supports. See vibration isolation and seismic restraint requirements.

#### 2.03 FLEXIBLE CONNECTIONS

- A. Flexible connections shall be made from "VENTGLAS", Neoprene coated glass fabric.

#### 2.04 DAMPER HARDWARE

- A. Dampers on exposed duct with shaft length of 12" or less shall be equipped with "VENTLOCK" #620 1/4" dial regulator; with shaft length of 12" to 20" with "VENTLOCK" #653 3/8" dial regulators and 607 end bearings.
- B. Larger dampers shall be controlled with "VENTLOCK" self-locking regulators #640 or #641 in 3/8" or 1/2" size and shall be installed with #607 end bearings.
- C. Damper operators on inaccessible finished ceilings shall be equipped with "VENTLOCK" #688 flush mounting concealed damper regulators.
- D. Equivalent damper hardware by Young Regulator is acceptable.

#### 2.05 ACCESS DOORS

- A. Provide access doors for adequate accessibility to dampers and other devices concealed within ducts, walls, inaccessible ceilings and floors. All duct access doors shall be double

panel construction with rigid insulation between the panels. See section 15100 for other requirements.

2.06 INSULATED ACOUSTICAL FLEXIBLE DUCT

- A. Provide where indicated on drawings Flexmaster Type 8M, UL 181 Class 1 flexible duct. Duct length shall not exceed sixty (60) inches or as indicated on the drawings. Duct shall not penetrate firewalls and shall not be used within five (5) feet of any unprotected fire wall penetration.
- B. The duct shall be constructed of a CPE fabric supported by helical wound galvanized steel. The fabric shall be mechanically fastened to the steel helix without the use of adhesives.
- C. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2 1/2 times the working pressure:  
 Positive: 6 inches w.g.  
 Negative: 4 inches w.g.
- D. The duct shall be rated for a velocity of at least 4000 feet per minute.
- E. Suitable for operating temperature range of -20°F to +250°F.
- F. Acoustical performance, when tested by an independent laboratory in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, SoundProperties, shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" Dia.	7	31	40	38	40	27
8" Dia.	12	29	36	35	38	22
10" Dia.	21	28	29	33	26	12

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested on accordance with ASTM E477 at a velocity of 2500 feet per minute, shall be at least:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" Dia.	5	8	7	8	11	15
8" Dia.	10	7	7	8	10	13
10" Dia.	9	6	6	5	9	13

The self generated sound power level (LW) dB re 10-12 Watt of a 10 foot length of duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

Octave Band	2	3	4	5	6	7
Hz.	125	250	500	1000	2000	4000
6" Dia.	42	31	23	18	17	21
8" Dia.	41	34	27	19	18	21
10" Dia.	54	45	38	31	27	23

- G. Factory insulate the flexible duct with fiberglass insulation. The R-value shall be at least 4.2 at a mean temperature of 75°F.
- H. Cover the insulation with a fire retardant metalized vapor barrier jacket reinforced with cross-hatched scrim having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E96, Procedure A.

## 2.07 DUCT LINER

- A. Internal insulation shall be 1" thick flexible fiberglass duct liner conforming to NFPA 90-A, UL 181, and ASTM 1071, 2 pounds per cubic foot minimum density with EPA certified anti-microbial treatment, and with a noise reduction coefficient of 0.70. Material shall be KNAUF Duct Liner EM. Duct Lining shall be applied in accordance with the latest edition of SMACNA, HVAC Duct Construction, Standard Metal and Flexible manual. When ducts are exposed to outside ambient conditions (attics, boiler rooms, etc.), use 2" thick liner unless the ductwork is also externally insulated.
- B. Secure all insulation continuously to the inside of the ductwork, coated side to air stream, with fire-resistive adhesive as recommended by the insulation manufacturer. In addition to the adhesive, secure all insulation to all top, side and bottom panels with mechanical fasteners on 16" max. centers, using spot welded-on pins and push-on type clips. Pins shall not compress the insulation more than 1/8 of an inch. Repair all torn, snagged, and damaged places in the insulation coating with fire resistive adhesive before final installation of ductwork. Seal all abutting edges of insulation with fire resistive adhesive. Arrange all insulation to avoid interference with dampers, and provide a sheet metal liner between the insulation and each damper.
- C. Allowance has NOT been made in the duct sizes for the liner. Oversize sheet metal to accommodate insulation total thicknesses.
- D. Insulate first ten feet of ductwork from roof exhaust fan(s), VAV terminals, and as indicated. Also insulate all rectangular low pressure ductwork in equipment rooms. Duct liner shall be 1" thick (2" in boiler rooms and for exterior ductwork) or as indicated.

## 2.08 AIR DISTRIBUTION DEVICES

- A. GENERAL:
  - 1. All outlet grilles shall have gaskets.
  - 2. Unless otherwise noted, sidewall devices and ceiling devices shall be off-white baked enamel.
  - 3. Furnish opposed blade volume control dampers on supply, return, and exhaust devices, where indicated.
  - 4. Where device is to lay in a tee bar ceiling, verify grid dimensions. Device shall be square with nominal dimension of side same as shorter grid dimension. That is, provide 24" x 24" nominal panel with 24" x 48" grid, etc.
  - 5. Ceiling devices shall be compatible with ceiling construction.
  - 6. Test devices in accordance with ASHRAE 70.
- B. DEVICES:
  - 1. Devices shall be by Price, Krueger, Metalaire or Titus.
  - 2. Perforated face diffusers with pattern controllers on the face will not be accepted.

## 2.09 FIRE AND SMOKE DAMPERS

- A. Fire dampers, radiation dampers, and fire-smoke dampers shall be following RUSKIN model numbers, or equivalent as manufactured by Nailor, Ruskin, or Greenheck.

- B. Fire dampers and fire smoke dampers shall be UL-listed and shall conform to UL 555 or UL 555S latest edition. Dampers shall be dynamic type. Dampers shall be licensed to bear the AMCA Standard label
- C. Dampers for horizontal duct mounting shall be Model D-IBD2 Style B or C (D-IBD2 Style C or CO for medium and high-pressure duct. Seal duct to collars to make airtight.)
- D. Damper for vertical mounting shall be same but with closure springs and latches for vertical ducts.
- E. Smoke dampers shall be Model SD60 with actuators out of the air stream (air foil blades, low leakage, with 115V actuator unless otherwise required by Electrical or Controls division).
- F. Fire/smoke dampers shall be Model FSD60 with actuators out of the air stream (air foil blades, low leakage, with 115V actuator unless otherwise required by Electrical or Controls division).
- G. Furnish dampers with sleeves and collars that are compatible with wall and duct applications.
- H. Smoke damper and combination fire and smoke damper actuators shall be "controlled closure" type.
- I. Ceiling radiation dampers shall be CFD with thermal insulation blanket. Furnish dampers that are compatible with the ceiling as applicable.

#### 2.10 LOUVERS

- A. Weatherproof louvers shall be by Ruskin model numbers below, or equivalent by Empco, American Warming and Ventilating, or Industrial Louver, and shall bear the AMCA Certified Ratings Seal.
- B. Stationary type shall be Ruskin extruded aluminum, high performance type, drainable model ELF-6375DX, constructed of 0.080" aluminum, 37.5° blades on 5.9" centers, 6" deep frames. Louvers shall have 55 percent free area based on 48" height and water penetration shall not exceed 0.01 oz./sq.ft. per 15 minutes at 1006 FPM thru free area based on a water flow rate of 0.25 gal./min. Pressure drop shall not exceed 0.075 inches SPWG at 700 FPM thru free area. Furnish with bird screen.
- C. Louvers installed in face brick walls shall be furnished without flanges for recessing; otherwise furnish with flanges. Coordinate louvers for receiving walls.
- D. Brick vents shall be model BVC cast aluminum with bird screen. Furnish with dampers when indicated.
- E. Coordinate louver finishes and colors with Architect. Submit samples.

#### 2.11 TURNING VANES

- A. Turning vanes shall be Aerodyne HEP high efficiency type with extended trailing edges. Pressure drop shall not exceed 0.06 inches SPWG at 1500 FPM with vanes on 2.4 inch centers (0.027 inches SPWG @ 1000 FPM, and 0.105 inches SPWG @ 2000 FPM). Submit test data for approval. Turning vanes shall be perforated metal type with internal insulation where duct is internally insulated.

2.12 MULTI-BLADE DAMPERS

- A. Multi-blade dampers shall be by Empco, American Warming & Ventilating, Industrial Louver or Ruskin.
- B. Two-position control dampers may be parallel blade type. Modulating or balancing dampers shall be opposed blade type.
- C. Motorized outside air dampers shall have vinyl or stainless steel blade seals and stainless steel jamb seals.

PART 3 – EXECUTION

3.01 GENERAL

- A. All ductwork not specifically indicated on drawings or specified elsewhere to be medium- or high-pressure duct shall be fabricated, braced and erected in accordance with SMACNA "HVAC Duct Construction Standards" or the latest edition of ASHRAE "Handbook" at the SPWG Class Construction specified previously.
- B. Adhere to drawings as closely as possible. However, where required to meet structural or other interferences, vary the run and shape of ducts and make offsets during progress of work. Offsets shall be made at 45 degrees or less. Duct routes shall be established and field measurements shall be taken before ductwork is fabricated. Coordinate where pipes or other items are placed around the item. If duct collars for registers or grilles obstruct more than 10% of the cross sectional area, the duct shall be enlarged to accommodate obstruction.
- C. All changes of direction and elbows shall be fitted with turning vanes. Standard radius elbows having centerline radius of 1.5x duct width may be used if space permits. Refer to Fig. 2-2, SMACNA "Duct Construction Standards". Types RE1, RE 2, RE 3 and RE 5 are acceptable. Type RE 4, RE6 thru RE10 shall NOT be used. Mitered elbows greater than 40 degrees shall have turning vanes.
- D. Branch duct take-offs shall be flared, cone, or wye type.
- E. Ductwork shall be free of any objectionable self-generating noise or rattles.
- F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of system, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- G. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.
- H. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.02 DUCTWORK APPLICATION SCHEDULE

AIR SYSTEM	MATERIALS
Supply Air, Transfer Air	Steel

Return, Relief, Make-up Air	Steel
General Exhaust	Steel
And as specified	

### 3.03 ADJUSTING AND CLEANING

- A. If the ends of the ducts are not covered during construction the contractor shall clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access into ductwork for cleaning purposes. Any cleaning of duct systems shall comply with recommendations of NAIMA and NADCA.

### 3.04 MANUAL BALANCING DAMPERS

- A. All low pressure branch ducts on either supply, return or exhaust shall be provided by some means of balancing in addition to dampers at registers and diffusers where indicated.
- B. Splitter dampers shall be made of at least the same thickness material as duct (minimum thickness 22-gauge). They shall be securely hinged at air leaving edge and made of 2 thicknesses so that entering edge presents a rounded surface to airflow. Provide splitter dampers only where indicated.
- C. Butterfly dampers up to 18" wide shall be made of minimum 22-gauge galvanized steel. Dampers up 48" wide shall be made of minimum 16-gauge galvanized steel. Butterfly dampers may be used in ducts with heights up to 10". Dampers that require blades over 10" high shall be multi-blade louver dampers. Refer to Fig. 2-12 and 2-13, SMACNA "Duct Construction Standards", First Edition, 1985. Fig. D shall NOT be used.
- D. Multi-blade louver dampers used for balancing shall be of the opposed blade type. Damper blades shall be constructed of 16-gage steel. Individual blade width shall not exceed 10" and blade length shall not exceed 48".
- E. All dampers shall be so constructed and installed that there shall be no vibration due to airflow over damper.

### 3.05 ACCESS DOORS

- A. Access doors shall be provided at all dampers, equipment in duct, and as shown on drawings.
- B. Access doors shall be minimum of 10" x 12" unless a larger size is required for maintenance of equipment or a smaller size must be used because of small duct size.

### 3.06 FLEXIBLE DUCT INSTALLATION

- A. Install without sharp bends, sags or dips.
- B. Secure to rigid duct and diffuser neck with minimum of two bands; one for the flexible duct and one for the insulation covering.

### 3.07 SEALING

- A. Seal all duct joints to the seal class in SMACNA Table 1-2 based on the construction class specified in 1.01 previously but the minimum seal class for all ductwork shall be

seal class "C."

### 3.08 FLEXIBLE CONNECTIONS

- A. Furnish and install flexible connections on the inlet and outlet of each fan and unit to which duct connections are made.
- B. At least 1" slack shall be allowed in these connections to insure that no vibration is transmitted from fan to ductwork.
- C. The fabric shall either be folded in with the metal or attached with metal collar frames at each end to prevent air leakage.

### 3.09 FIRE DAMPERS, SMOKE DAMPERS, RADIATION DAMPERS

- A. Fire and/or smoke dampers shall be installed where indicated on drawings.
- B. Dampers shall be installed to conform to the UL listing for the specific dampers.

### 3.10 LOUVERS

- A. Recess louvers in face brick walls approximately 0.25".
- B. Mount units rigidly to walls and make weatherproof. Set brick vents and brick louvers in place during masonry erection.

### 3.11 DUCT LINER

See drawings for additional ductwork requiring duct liner.

### 3.12 EXAMINATION

Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

### 3.13 INSTALLATION

Install diffusers, registers, and grilles level and plumb, according to manufacturer's written instructions.

Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of the panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

Install diffusers, registers, and grilles with airtight connection to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

### 3.14 ADJUSTING

After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

3.15 CLEANING

After installation of diffusers, registers, and grilles, inspect exposed finish. Clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.

END OF SECTION 15800