

**SECTION 233300 – DUCTWORK ACCESSORIES**

- 1.0 Each branch duct to individual diffusers and registers shall have a balancing damper, located as far away from the air terminal as possible. Dampers shall be located as close as possible to the location where the duct branches off of the main. Dampers in diffusers and registers shall be used for fine tuning the airflow only. Dampers supported by cantilevered shafts are prohibited. All shafts shall extend through the duct and be supported at both ends. Dampers 11" high and smaller shall be single-blade type. Dampers 12" high and larger shall be multi-blade, opposed-blade type. On insulated ductwork, control shaft shall be extended and provided with mounting bracket so that damper regulator can be installed at the surface of the insulation. Excessive, unnecessary balancing dampers upstream of VAV boxes shall be avoided.
- 2.0 Specify flexible connections not less than 3" wide at the inlet and outlet of all rotating equipment and at all building expansion joints. The clear space between connected parts shall be minimum 3", and the connection shall have minimum additional 1.5" slack material. The connector fabric shall be fire retardant and asbestos free. All connectors shall be UL listed. The A/E shall include special requirements for flexible connections where air stream contaminants, temperature or pressure may necessitate the use of heavy duty or corrosive resistant materials. Outdoor connectors shall be ozone and UV resistant and shall be rated for constant maximum temperature of 250 degrees F.
- 3.0 Access doors must be installed both upstream and downstream of all duct mounted equipment including but not limited to:
  - A. Coils (including VAV box mounted reheat coils)
  - B. Fire and smoke dampers
  - C. Automatic dampers
  - D. Filters
  - E. Controls
  - F. Humidifiers
  - G. Airflow measuring devices
  - H. In-line fans
- 4.0 All access doors shall be hinged and be constructed of a minimum 22 gauge materials or as required by duct construction. The doors shall be installed with stiffening frames constructed from angle supports and provided with continuous hinges. Doors shall be fabricated of the same material as the ductwork with closed cell full sealing gaskets and quick fastening locking devices. For insulated ductwork, fabricate double wall door with internal insulation not less than the thickness of the adjacent ductwork or casing. Minimum door size shall be 18"x18". Make as large as possible where the size of the duct will not support this size.
- 5.0 Sound attenuators shall be installed on all systems as required to meet the specified noise criteria levels in Part I, General Section XI "Noise and Vibration Control" and Part II, Section 230000 "HVAC Systems". Use of sound attenuators shall be based on an analysis by a qualified acoustics consultant. Sound attenuators shall have internal baffles filled with inorganic incombustible glass fiber acoustic

material. Exposed filler material in contact with the air-stream is not acceptable. Interior liner shall be perforated with a tedlar sheet and acoustic stand-off between the perforated interior liner and filler material.

- A. Where multiple sound attenuators are grouped together in-parallel within a duct system or air handling unit, seal them airtight with sealant.
  - B. Provide gradual transition duct fittings between attenuators and connecting ductwork, where attenuators are of a different size than the ductwork.
- 6.0 Fire dampers shall be of the out-of-air stream design (i.e., Type B: Hi-hat profile, 90 percent free area, average 0.053 inch w.g. loss at 2000 fpm). Frames shall be minimum 20 gage galvanized steel channel. Blades shall be minimum 24 gage galvanized steel curtain type. Closure springs shall be type 301 stainless steel. All fire dampers shall be rated as dynamic type. All system designs will conform with the following:
- A. The locations of all fire dampers must be indicated on the drawings as required to meet applicable codes.
  - B. Both NFPA and SMACNA design standards must be referenced as a standard for the installation of the dampers.
  - C. Each fire damper shall be field tested to ascertain proper operation.
  - D. The supplier of the fire dampers must provide two (2) additional fusible links for each fire damper installed.
  - E. Where multiple fire damper actuators are powered from a single circuit, each fire damper must be provided with a separate disconnecting means.
- 7.0 Registers and diffusers shall be of the hinged type (where applicable), shall be steel (except as noted below) with factory baked enamel finish of color selected by architect, and shall be designed as follows:
- A. Air outlets shall be selected to result in a maximum occupied space velocity of 35 feet per minute at normally occupied locations and 3 feet below the ceiling.
  - B. Throws based upon a terminal velocity of 50 FPM, shall not exceed 1/2 the distance between adjacent diffusers or 67% of the distance between the outlet and the wall.
  - C. In addition to balancing dampers furnished at branch take-offs from mains, all units shall be provided with opposed blade dampers.
  - D. Aluminum units shall be installed in wet areas or areas with high moisture content.
  - E. Non-dumping type supply outlets shall be specified for use in VAV systems. Analyze the outlet's performance at minimum airflow conditions.
  - F. All supply and return units shall have a maximum neck velocity of 500 FPM.
  - G. "Lay-in" type units are preferred.
  - H. The design of the outlet locations should consider accessibility requirements for the use of airflow balancing hoods (consider clearance space from furniture below and the location of walls and demountable partitions, etc.).

- 8.0 Intake and exhaust louvers shall be fixed and drainable, and designed within the following parameters:
- A. Intake:
    - 1. Maximum free area velocity: 750 FPM
    - 2. Maximum water penetration: Less than 0.14 ounces/sq.ft. 15 Minute duration.
    - 3. Maximum pressure drop: Less than 0.15 in. w.g.
    - 4. Minimum free area: 45% of face area
    - 5. Bird screen
  - B. Exhaust:
    - 1. Maximum free area velocity: 1000 FPM
    - 2. Minimum free area: 45% of face area
    - 3. Maximum pressure drop: 0.25 in. w.g.
    - 4. Bird screen.
  - C. All unused portions of supply air and exhaust louvers shall be blanked off with an insulated No. 18 gauge galvanized steel sheet metal sandwich panel.
  - D. The A/E shall analyze the selection and location of louvers to account for snow infiltration and contaminants (refer to the indoor air quality discussion in Section 230000).
- 9.0 Duct coils shall be supported independently of the connected ductwork.
- 10.0 Single duct shut-off air volume control boxes shall be DDC-powered, system static pressure independent throughout their operating range, equipped with multi-point center-averaging & amplified velocity pressure sensor, gasketed control damper, bottom access door, 1" fiberglass board with reinforced aluminum foil faced liner, hanger brackets and dust tight sealed control enclosure.
- A. Provide hot water, or electric, heating coils where indicated.
  - B. Provide integral sound attenuators where indicated. Provide casings constructed of 20-gauge galvanized steel, where boxes are to be installed within 50 feet of the supply fan outlet.
  - C. Design shall ensure that controls section of each VAV box is easily accessible for service.
  - D. Static pressure sensor connections (tee) at VAV boxes shall be brass with brass plugs.
- 11.0 Modulating dampers shall be sized for linear airflow control within the angle of rotation with minimum pressure drop. The units shall be constructed of minimum 16 gauge galvanized steel frames and blades having a maximum width of 6". Each blade shall be constructed with edge seals and shall be sealed to minimum 1/2" steel angles. End bearings shall be of the self-lubricating type. Maximum damper leakage shall be 2% when closed across a 4" static pressure differential.
- 12.0 Backdraft dampers shall be industrial, low-leakage, parallel-blade type, with double-thickness airfoil blades and blade seals, complete with adjustable counterweights and linkage for the duty.
- 13.0 Bubble-tight dampers shall utilize heavy duty fast acting 120V electric actuators. Dampers shall be bubble tight at 10" W.G. Dampers shall be constructed of 316 stainless steel with silicone gaskets and stainless steel shafts. Bubble tight dampers shall be installed where indicated on plans.

- 14.0 Airflow measuring stations shall be provided for VAV systems on the discharge of air handling units, inlets of return, outdoor air and exhaust systems and other locations as required for system control requirements. (Refer to Section 230500).
- 15.0 Provide turning vanes in all square throat rectangular duct elbows, installed on runners. Install single-thickness vanes up to a length of 36"; double thickness vanes in greater lengths. Provide 4" radius vanes wherever possible; 2" radius only where 4" vanes cannot be installed. Modify vane shape or angle of entry/exit for unequal entry/exit elbows.