

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and Divisions 00 and 01, apply to this Section.
- B. Related Sections:
 - 1. Division 08.
 - 2. Division 23.
 - 3. Division 28.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Remote control volume dampers.
 - 4. Fire dampers.
 - 5. Ceiling fire dampers.
 - 6. Smoke dampers.
 - 7. Combination fire/smoke dampers.
 - 8. Duct silencers.
 - 9. Roof ventilation hoods.
 - 10. Turning vanes.
 - 11. Duct-mounted access doors.
 - 12. Flexible ducts.
 - 13. Flexible connectors.
 - 14. Screened openings.
 - 15. Duct accessory hardware.

1.3 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Manual-volume dampers.
 - 3. Fire, smoke and combination fire/smoke dampers: Include fire protection rating, maximum velocity and static pressure rating.
 - 4. Ceiling fire dampers.
 - 5. Duct silencers.
 - 6. Duct-mounted access doors and panels.
 - 7. Flexible connectors.
 - 8. Flexible ducts.
 - 9. Roof ventilation hoods.
 - 10. Fire, smoke, and combination fire/smoke damper schedule: Include design drawing sheet number for reference, location based on drawings and grids, model number, size, free area, airflow, and velocity for each damper.

- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
 - 1. Special fittings and manual-volume-damper installations.
 - 2. Fire, smoke, and combination fire/smoke damper installations, including project specific installation detail for each damper and/or wall type sleeves and duct-mounted access doors and panels.
- C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.
- D. Maintenance Data: UL installation instructions for each type of fire, smoke, and combination fire/smoke damper to be included in maintenance manuals specified in Division 01.

1.4 CODES AND STANDARDS

- A. Codes and Standards shall be the current version adopted by the Authority Having Jurisdiction.

1.5 QUALITY ASSURANCE

- A. NFPA Compliance: Comply with the following NFPA standards:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
 - 3. NFPA 101, "Life Safety Code."
 - 4. NFPA 92A, "Smoke Controls Systems."
 - 5. NFPA 92B, "Smoke Control Systems in Atria, Covered Malls, and Large Areas."

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 – PRODUCTS

2.1 SHEET METAL MATERIALS

- A. Galvanized, Sheet Steel: Lock-forming quality; ASTM A 653/A 653M, G90 coating designation; mill-phosphatized finish for surfaces of ducts exposed to view.
- B. Carbon-Steel Sheets: ASTM A 366/A 366M, cold-rolled sheets, commercial quality, with oiled, exposed matte finish.
- C. Stainless Steel Sheets: ASTM A480/A480M, flat-rolled steel plate, sheet, and strip. One-side bright finish for ducts exposed to view and mill finish for concealed ducts.
- D. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view and mill finish for concealed ducts.

- E. Extruded Aluminum: ASTM B 221, Alloy 6063, Temper T6.
- F. Reinforcement Shapes and Plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- G. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Backdraft Dampers:
 - a. Ruskin.
 - b. American Warming & Ventilating.
 - c. Greenheck.
 - d. Or Approved Equal
- B. Description: Suitable for horizontal or vertical installations as indicated.
- C. Counterbalance Type: Extruded aluminum with counterbalanced blades; blades begin to open at minimum 0.01 inches w.g. and be fully open at minimum 0.05 inches w.g. Designed for maximum 3500 feet per minute spot velocity and up to 4-inches w.g. back pressure.
 - 1. Frame: Minimum 0.125 inches thick extruded aluminum, braced at corners.
 - 2. Blades: Minimum 0.070 inches thick extruded aluminum. Blade seals extruded vinyl, mechanically attached.
 - 3. Bearings: Corrosion resistant, long life synthetic.
 - 4. Linkage: 1/2-inch diameter tie bar with stainless steel pivot pins; mounted on blades. Adjustable counterbalance.
- D. Top-of-Blade Hinged Type: Extruded aluminum heavy duty backdraft dampers; blades begin to open at minimum 0.12 inches w.g. and be fully open at minimum of 0.20 inches w.g. Designed for maximum 3500 feet per minute spot velocity.
 - 1. Frame: Minimum 0.125 inches thick extruded aluminum, braced at corners.
 - 2. Blades: Minimum 0.070 inches thick extruded aluminum. Blade seals extruded vinyl, mechanical attached.
 - 3. Bearings: Corrosion resistant, long life, synthetic.
 - 4. Linkage: 1/2-inch diameter tie bar with stainless steel pivot pins; mounted on blades.

2.3 MANUAL-VOLUME DAMPERS

- A. General: Factory fabricated with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
 - 1. Pressure Classifications of 3-Inch wg or Higher: End bearings or other seals for ducts with axles full length of damper blades and bearings at both ends of operating shaft.

- B. Steel Standard Volume Dampers: Multiple- or single-blade, opposed-blade design unless indicated otherwise, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 16 gauge thick, galvanized, sheet steel.
 3. Blade Axles: Galvanized steel.
 4. Tie Bars and Brackets: Galvanized steel.
- C. Aluminum Standard Volume Dampers: Multiple- or single-blade, opposed-blade design unless indicated otherwise, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Aluminum Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Aluminum Blades: [Roll-formed 0.10-inch thick aluminum sheet][Extruded 0.050-inch thick extruded aluminum].
 3. Blade Axles: Nonferrous.
 4. Tie Bars and Brackets: Aluminum.
- D. Steel Low-Leakage Volume Dampers: Multiple- or single-blade, opposed-blade design unless indicated otherwise, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized, sheet steel channels, minimum of 16 gauge thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Steel Blades: 16 gauge thick, galvanized, sheet steel.
 3. Blade Seals: [Felt][Vinyl][Neoprene].
 4. Blade Axles: Galvanized steel.
 5. Tie Bars and Brackets: Galvanized steel.
- E. Aluminum Low-Leakage Volume Dampers: Multiple- or single-blade, opposed-blade design unless indicated otherwise, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Aluminum Frames: Hat-shaped, 0.063-inch thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing ducts.
 2. Aluminum Blades: [Roll-formed 0.10-inch thick aluminum sheet][Extruded 0.050-inch thick extruded aluminum].
 3. Blade Seals: [Felt][Vinyl][Neoprene].
 4. Blade Axles: Nonferrous.
 5. Tie Bars and Brackets: Aluminum.
- F. Steel High-Performance Volume Dampers: Multiple- or single-blade, opposed-blade design unless indicated otherwise, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.

1. Steel Frames: Hat-shaped, galvanized steel channels, minimum of 0.064-inch-thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Steel Blades: 18 gauge thick, galvanized, sheet steel; airfoil shaped.
 3. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.
 4. Blade Axles: Galvanized steel.
 5. Tie Bars and Brackets: Galvanized steel.
- G. High-Performance Volume Dampers: Multiple- or single-blade, opposed-blade design unless indicated otherwise, low-leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Aluminum Frames: Hat-shaped, 0.125-inch thick, extruded-aluminum channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Extruded-Aluminum Blades: Minimum of 0.081-inch thick, 6063T extruded aluminum.
 3. Blade Seals: Dual-durometer vinyl on blade edges; metallic compression on jambs.
 4. Blade Axles: Nonferrous.
 5. Tie Bars and Brackets: Aluminum.
- H. Jackshaft: 1-inch diameter, galvanized steel pipe rotating within a pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
1. Length and Number of Mountings: Appropriate to connect linkage of each damper of a multiple-damper assembly.
- I. Damper Regulators: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 REMOTE CONTROL VOLUME DAMPERS

- A. General: The remote-control system shall provide means of balancing airflow in ductwork above inaccessible ceilings.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. United Enertech
 2. Greenheck
 3. Or Approved Equal
- C. Description: Multiple- or single-blade unit with sleeve, suitable for horizontal or vertical applications, standard leakage rating, zinc-plated steel axle with linkage outside airstream, DC voltage drive actuator, with adjustments accomplished by a hand-held battery power pack,
- D. Ratings: Volume damper unit with ratings as follows:
1. Pressure: 1 in. wg pressure differential
 2. Velocity: 2000 fpm
 3. Temperature: 180 deg F

- E. Round Units: Single blade unit with molded synthetic sleeve type bearings, zinc plated steel axles, and casings with minimum sheet metal thicknesses for diameters listed below:
 - 1. Steel frames: 24-gauge galvanized steel for diameters 4 through 10 inches, 20-gauge galvanized steel for diameters 12 through 24 inches.
 - 2. Steel Blades: single blade 24-gauge galvanized steel for diameters 4 through 10 inches; 20-gauge galvanized steel for diameters 12 through 24 inches.

- F. Rectangular Units: Multiple- or single-blade unit with side plate frame and the following features:
 - 1. Frame: 0.081 inches extruded aluminum, 4-1/2 inches deep.
 - 2. Blade: 0.125 inches extruded aluminum multiple opposed blades with blade seals; exception: formed aluminum single blade through 12-inch height.
 - 3. Bearings; bronze Oilite
 - 4. Axles: 1/2-inch diameter zinc plated steel with thrust bearing
 - 5. Side Plate: 6-1/4-inch x (height + 1-inch) x 18-gauge galvanized steel thickness

- G. Remote Operated Damper Regulators: DC low voltage operated drive actuator with platform suitable for insulated duct mounting, plenum-rated electric cable, cable connectors, female receptacle single or multi-port remote wall or ceiling plate, color white or coordinated with Architect, hand held battery power pack to control actuator.

2.5 FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fire Dampers:
 - a. Ruskin.
 - b. Air Balancing, Inc.
 - c. Greenheck.
 - d. National Controlled Air.
 - e. Or Approved Equal.

- B. General: Curtain type fire damper, listed and labeled for UL 555 "Standard for Fire Dampers" for use in dynamic systems. Damper shall close with air velocity of 2000 fpm and 4-inch w.g. static pressure with airflow horizontal either direction, airflow up or airflow down.

- C. Fire Rating: 1-1/2 hours unless indicated otherwise.

- D. Frame: SMACNA Type B style with blades out of airstream; fabricated with roll-formed, minimum 20-gauge thick galvanized steel; with mitered and interlocking corners.

- E. Mounting Sleeve: Factory- or field-installed galvanized, sheet steel.
 - 1. Minimum Thickness: 20-gauge or 0.138-inch-thick as indicated, and length to suit application. Provide retaining angles.
 - 2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

- F. Mounting Orientation: Vertical or horizontal as indicated.
- G. Blades: Roll-formed, interlocking, minimum 24-gauge thick, galvanized, sheet steel. In place of interlocking blades, use full-length, minimum 24-gauge thick, galvanized steel blade connectors.
- H. Closure Spring: Include stainless-steel constant force closure spring.
- I. Fusible Link: Replaceable, 165 deg F rated unless indicated otherwise.

2.6 STAINLESS STEEL FIRE DAMPERS FOR MOIST ENVIRONMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Fire Dampers:
 - a. Ruskin.
 - b. Air Balancing, Inc.
 - c. Greenheck.
 - d. National Controlled Air.
 - e. Or Approved Equal.
- B. General: Round single-blade fire damper, listed and labeled for UL 555 "Standard for Fire Dampers" for use in dynamic systems. Damper shall close with air velocity of 2000 fpm and 4-inch w.g. static pressure with airflow horizontal either direction, airflow up or airflow down.
- C. Fire Rating: 1-1/2 hours unless indicated otherwise.
- D. Mounting Sleeve: Factory-installed integral sleeve. Field-installed galvanized sheet steel cinch plates.
 - 1. Minimum Thickness: 20-gauge or 0.138 inch thick.
 - 2. Exceptions: Provide one or two cinch plates as required to be compatible with wall construction materials used.
- E. Mounting Orientation: Vertical or horizontal as indicated.
- F. Blade/axle: Single skin 14-gauge thick, stainless sheet steel, and 1/2" stainless steel axle.
- G. Bearings: Stainless steel sleeve, pressed into frame. Closure Spring: Include stainless-steel constant force closure spring.
- H. Fusible Link: Replaceable, 165 deg F rated unless indicated otherwise.

2.7 CEILING FIRE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ceiling Fire Dampers:

- a. Ruskin.
 - b. Air Balancing, Inc.
 - c. Greenheck.
 - d. National Controlled Air.
 - e. Or Approved Equal.
- B. General: Labeled to UL 555C "Ceiling Dampers"; comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Minimum 20-gauge thick, galvanized, sheet steel; round or rectangular; style to suit ceiling construction.
- D. Blades: Minimum 22-gauge thick, galvanized, sheet steel with U.L. Classified nonasbestos refractory insulation.
- E. Volume Adjustment: UL-labeled, fusible volume-control adjustment.
- F. Fusible Link: Replaceable, 165 deg F rated unless specifically indicated, 212 deg F or 285 deg F.

2.8 SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 1. Smoke Dampers:
 - a. Ruskin.
 - b. Air Balancing, Inc.
 - c. Greenheck.
 - d. National Controlled Air.
 - e. Or Approved Equal.
- B. General: Listed and labeled to UL 555 and UL 555S. Dampers shall have the ability to operate against pressures up to 4-inches w.g. and velocities up to 2,000 fpm. Class I leakage rating. Controlled gradual closure between 10 and 15 seconds. Automatic remote reset after test, smoke detection, or power failure.
- C. Temperature Rating: 350 degrees F.
- D. Frame: Minimum 16-gauge thick, galvanized, sheet steel.
- E. Blades: Minimum 16-gauge thick, galvanized sheet steel. One piece airfoil type blades. Flexible stainless steel compression type jam seals. Silicone blade edge seals capable of withstanding 450 degrees F.
- F. Mounting Sleeve: Factory-installed, minimum 18-gauge thick, galvanized, sheet steel; length to suit wall or floor application.
- G. Controlled Closure Device: Heat activated electric fuse link, 165 deg. F unless noted otherwise.

- H. Damper Test Switch: Provide test switch for cycling damper.
- I. Blade Position Indicator Switch: Provide blade position two-position indicator switch for remote monitoring of blade position.
- J. Damper Actuator(s): Provide factory mounted actuator for exterior mounting unless indicated otherwise. Actuator shall have spring return to allow damper to fail in closed position and require power to position damper open. Coordinate actuator power voltage (120VAC or 24VAC) with Electrical.

2.9 COMBINATION FIRE/SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Combination Fire/Smoke Dampers:
 - a. Ruskin.
 - b. Air Balance, Inc.
 - c. Greenheck.
 - d. National Controlled Air.
 - e. Or Approved Equal.
- B. General: Labeled to UL 555 "Standard for Fire Damper" for 1-1/2 or 3-hour fire damper. Labeled to UL 555S "Standard for Leakage Rated Dampers for use in Smoke Control Systems". Open and close under operating conditions up to 4-inches w.g. in closed position and 3000 fpm in open position. Class I leakage rating. Controlled gradual closure between 10 and 15 seconds. Automatic remote reset after test, smoke detection or power failure.
- C. Fire Rating: [1-1/2 hours][1-1/2 and 3 hours].
- D. Resettable Heat Response Link: Electric heat-responsive sensing device, with reset button, 165 deg F rated unless specifically indicated 212 deg F, 250 deg F, or 285 deg F.
- E. Frame: Minimum 16-gauge thick, galvanized, sheet steel.
- F. Blades: Minimum 14-gauge single piece airfoil construction. Opposed blade action, unless indicated specifically parallel. Stainless steel bearings. Flexible stainless steel compression type joints seals. Silicone blade edge seals, capable of withstanding 450 deg F.
- G. Mounting Sleeve: Factory-installed, minimum 20-gauge thick, galvanized, sheet steel; length to suit wall or floor application.
- H. Blade Position Indicator Switch: Provide blade position two-position indicator switch for remote monitoring of blade position.
- I. Damper Motors: Provide for two-position action.
 - 1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments.

3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 4. Two-Position Motor: 115 V, single phase, 60 Hz.
- J. Refer to Electrical for smoke detector.

2.10 STAINLESS STEEL COMBINATION FIRE/SMOKE DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Combination Fire/Smoke Dampers:
 - a. Ruskin.
 - b. Air Balance, Inc.
 - c. Greenheck.
 - d. National Controlled Air.
 - e. Or Approved Equal.
- B. General: Stainless Steel construction and Labeled to UL 555 "Standard for Fire Damper" for 1-1/2-hour fire damper. Labeled to UL 555S "Standard for Leakage Rated Dampers for use in Smoke Control Systems". Open and close under operating conditions up to 4-inches w.g. in closed position and 3000 fpm in open position. Class I leakage rating. Controlled gradual closure between 10 and 15 seconds. Automatic remote reset after test, smoke detection or power failure.
- C. Fire Rating: 1-1/2 hours.
- D. Resettable Heat Response Link: Electric heat-responsive sensing device, with reset button, 165 deg F rated unless specifically indicated 212 deg F, 250 deg F, or 285 deg F.
- E. Frame: Minimum 16-gauge thick, [304 SS][316 SS], sheet steel, hat-shaped channel.
- F. Blades: Minimum 14-gauge single piece [304 SS][316 SS] triple V-groove construction. Parallel blade action. Stainless steel bearings, linkage, and axles. Flexible stainless steel compression type joints seals. Silicone blade edge seals, capable of withstanding 450 deg F.
- G. Mounting Sleeve: Factory-installed, minimum 20-gauge thick, galvanized, sheet steel; length to suit wall or floor application.
- H. Blade Position Indicator Switch: Provide blade position two-position indicator switch for remote monitoring of blade position.
- I. Damper Motors: Provide for two-position action.
1. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 2. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments.

3. Outdoor Motors and Motors in Outside-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 4. Two-Position Motor: 115 V, single phase, 60 Hz.
- J. Refer to Electrical for smoke detector.

2.11 DUCT SILENCERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Duct Silencers:
 - a. Industrial Acoustics Company.
 - b. Rink.
 - c. Vibro-Acoustics.
 - d. Dynasonics.
 - e. Semco.
 - f. Or Approved Equal.
- B. General: Factory-fabricated and -tested, round or rectangular silencer with performance characteristics and physical requirements as indicated.
- C. Fire Performance: Adhesives, sealers, packing materials, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E 84.
- D. Rectangular Units: Fabricate casings with a minimum of 22-gauge thick, solid sheet metal for outer casing and 26-gauge thick, perforated sheet metal for inner casing.
- E. Round Units: Casings with minimum sheet metal thicknesses for diameters listed below:
1. Up to 24 Inches: 22-gauge.
 2. 26 through 40 Inches: 20-gauge.
 3. 42 through 52 Inches: 18-gauge.
 4. 54 through 60 Inches: 16-gauge.
 5. Casings fabricated of spiral lock-seam duct may be one size thinner than that indicated.
 6. Interior Partitions and Baffles: At least 22-gauge and designed for minimum aerodynamic losses.
- F. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.
- G. Fibrous Acoustic-Fill Material: Inert and vermin-proof fibrous material, packed under not less than 15 percent compression. Bacteria and fungus resistant.
- H. Nonfibrous Acoustic-Fill Material: Moisture-proof nonfibrous material.
- I. Fibrous Acoustic-Fill Material with Film Lining: Inert and vermin proof fibrous material, packed under not less than 15 percent compression. Bacteria and fungus resistant. Fill material completely wrapped with Tedlar or Mylar film. The wrapped acoustic media separated from the perforated metal by an acoustically transparent spacer.

- J. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Silencer to withstand 8-inches w.g. differential pressure.
1. Do not use nuts, bolts, and sheet metal screws for unit assemblies.
 2. Lock form and seal or continuously weld joints.
 3. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
 4. Reinforcement: Cross or trapeze angles for rigid suspension.
- K. Source Quality Control: The following factory tests shall have been conducted on silencers identical to units required:
1. Acoustic Performance: Test according to ASTM E 477, with airflow in both directions through silencer.
 2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels, for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with an airflow of at least 2000-fpm face velocity.
 3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.
 4. Aerodynamic Performance: Pressure drops not to exceed those indicated. Pressure drop measurements in accordance with ASTM E 477 for units identical for which acoustical data is presented.

2.12 ROOF VENTILATION HOODS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Roof Ventilation Hoods:
 - a. Penn Ventilator.
 - b. Cook.
 - c. Greenheck.
 - d. Ruskin.
 - e. Or Approved Equal.
- B. General Description: Louvered penthouse, low silhouette hood, or low silhouette aluminum spun housing, curb base, and accessories. Rated for 20 psf wind/snow load.
- C. Housing: Heavy-gauge, removable, louvered or spun-aluminum, dome top and outlet baffle; square, one-piece, hinged, aluminum base.
- D. Accessories:
1. Bird Screens: Removable 1/2-inch mesh, 16-gauge, aluminum or brass wire.
 2. Insect Screens: Removable 1/8-inch mesh, aluminum or brass wire.
 3. Backdraft Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base, factory set to close when fan stops. Provide where indicated.
 4. Roof Curbs: Prefabricated, heavy-gauge, galvanized steel; mitered and welded corners; 2-inch thick, rigid, fiberglass insulation adhered to inside walls; built-in cant and mounting flange for flat roof decks; and 2-inch wood nailer. Size as required to suit roof opening and fan base.

2.13 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. **Manufactured Turning Vanes:** Fabricate of 1-1/2-inch-wide, curved blades set 3/4 inch o.c.; support with bars perpendicular to blades set 1-1/2-inches o.c.; and set into side strips suitable for mounting in ducts.
- C. **Acoustic Turning Vanes:** Fabricate of airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

2.14 DUCT-MOUNTED ACCESS DOORS

- A. **General:** Fabricate doors and panels airtight and suitable for duct pressure class. 14-inch wide by 14-inch high (or maximum height for ducts less than 14-inches in height), unless indicated otherwise.
- B. **Frame:** Unless indicated differently, minimum 24-gauge thick galvanized (or compatible with duct construction materials), sheet steel, with bend-over tabs and foam gaskets.
- C. **Door:** Double-wall, galvanized (or compatible with duct construction materials), sheet metal construction with insulation fill and thickness, and number of hinges and locks as indicated for duct pressure class. Include vision panel where indicated. Include piano hinge and cam latches. Multiple cam latches used on doors greater than 12-inches in height.
- D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.
- E. **Insulation:** 1-inch-thick, fibrous-glass.

2.15 FLEXIBLE CONNECTORS

- A. **General:** Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1. Fabricate designed to meet UL 214, NFPA 90A, airtight and waterproof.
- B. **Standard Metal-Edged Connectors:** Factory fabricated with a strip of fabric 3-inches wide attached to two strips of 3-inch-wide, minimum 24-gauge thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.
- C. **Extra-Wide Metal-Edged Connectors:** Factory fabricated with a strip of fabric 5-3/4 inches wide attached to two strips of 3-inch-wide, minimum 24-gauge thick, galvanized, sheet steel or 0.032-inch aluminum sheets. Select metal compatible with connected ducts.
- D. **Transverse Flanged Metal-Edged Connectors:** Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 4-3/8-inch-wide, 24-gauge thick, galvanized, sheet steel or 0.032-inch aluminum sheets formed for flanged type connection. Select metal compatible with connected ducts.
- E. **Conventional, Indoor System Flexible Connector Fabric:** Woven nylon/polyester blend with vinyl coating.
 - 1. **Minimum Weight:** 22 oz./sq. yd.

2. Tensile Strength: 240 lbf/inch in the warp, and 220 lbf/inch in the filling.
- F. Conventional, Outdoor System Flexible Connector Fabric: Glass fabric double coated with a synthetic-rubber, weatherproof coating resistant to the sun's ultraviolet rays and ozone environment.
1. Minimum Weight: 24 oz./sq. yd.
 2. Tensile Strength: 500 lbf/inch in the warp, and 500 lbf/inch in the filling.

2.16 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Flexible Ducts:
 - a. Thermaflex
 - b. Flexmaster
 - c. Wiremold
 - d. Or Approved Equal
- B. General: Comply with UL 181, Class 1, UMC Standard 6-1, and NFPA Standards 90A and 90B.
- C. Flexible Ducts, Insulated: Factory-fabricated, insulated, round duct, with an outer jacket enclosing 1-inch-thick, glass-fiber insulation around a continuous inner liner. Rated for maximum pressures of 10-inches wg positive and 1-inch wg negative. Insulation shall be Air Diffusion Council certified R-values. Product shall be low VOC, Greenguard certified.
1. Reinforcement: Steel spring coated wire helix supporting the inner liner.
 2. Outer Jacket: Metalized fiberglass crosshatch jacketing.
 3. Inner Liner: Chlorinated Polyethylene, acoustically rated.
- D. Flexible Ducts, Uninsulated: Spiral-wound steel spring coated wire helix supported with vinyl liner. Rated for maximum pressures of 10-inches wg positive and 2-inches wg negative and maximum velocity of 4000 fpm.

2.17 SCREENED OPENINGS

- A. Screened Openings: 16-gauge steel angle frame enclosing 1/2-inch mesh, 14-gauge galvanized steel wire screen.

2.18 ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.
- B. Splitter Damper Accessories: Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

- C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.
- D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.
- E. Concealed Damper Regulators: Gear operated linkage, minimum 3/8-inch diameter, steel rod, chrome plated ceiling cover, flush mount.
- F. Duct Smoke Detector end caps: Match duct construction material to seal around penetrations.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.
- B. Volume Dampers:
 - 1. Install volume dampers at all diffuser and grille duct connections. Place as far upstream as layout and accessibility allow.
 - 2. Install manual volume dampers in lined duct; avoid damage to and erosion of duct liner.
- C. Concealed Damper Regulators: Install concealed damper regulators in locations where manual volume dampers are inaccessible above ceilings or behind walls.
- D. Remote Operated Damper Regulators: Install remote operated damper regulators in locations where manual volume dampers are inaccessible above ceilings or behind walls in accordance to manufacturer's installation instructions. Install remote wall plate or ceiling plate in location coordinated with Architect. Install cable from the damper to the remote female outlet plate. Label outlet plate with permanent label for area served. Provide hand held power pack. Contractor shall turn over the hand-held power pack to the owner after balancing is complete.
- E. Damper Actuators: Actuators shall not be mounted in the air stream.
- F. Maximum length of flexible duct is six feet.
 - 1. Support at manufacturer's recommended intervals but at minimum every 5-feet.
- G. Provide instrument test holes where indicated.
- H. Install combination fire/smoke, fire and smoke dampers according to manufacturer's UL-approved written instructions. Provide stainless steel dampers in stainless steel duct systems, and moist air aluminum duct systems.
- I. Install duct access panels for access to both sides of duct coils and every 50-feet of duct run for general inspection. Install duct access panels downstream from branch volume dampers, fire dampers, smoke dampers, combination fire/smoke dampers, turning vanes, and equipment.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.
 2. Install access panels on side of duct where adequate clearance is available.
- J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment."
- K. Duct Drains: Provide low point drains in moist ducts, and route to nearest floor drain or as indicated.

3.2 ADJUSTING

- A. Adjust duct accessories for proper settings.
- B. Adjust fire and smoke dampers for proper action.
- C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION