

SECTION 233300 AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, Division 23 Specification Sections, and Common Work Requirements for HVAC apply to the work specified in this Section.

1.2 SUMMARY

A. Section Includes:

1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Control dampers.
4. Fire dampers.
5. Smoke Dampers.
6. Combination fire and smoke dampers.
7. Turning vanes.
8. Duct-mounted access doors.
9. Flexible connectors.
10. Flexible ducts.
11. Duct accessory hardware.
12. Wire mesh grilles.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For all accessories specified, include construction details, dimensions, materials, finishes, bearings, and compliance with applicable codes.
2. Performance: Show compliance with pressure drops or specific requirements noted.
3. Provide manufacturer's installation instructions.
4. For duct silencers/sound attenuators, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.

- c. Control damper installations.
 - d. Wiring Diagrams: For power, signal, and control wiring.
 - C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
 - D. Source quality-control reports.
 - E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.
- 1.4 QUALITY ASSURANCE
- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
 - B. Comply with AMCA 500-D testing for damper rating.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G60 G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.
- E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 BACKDRAFT AND PRESSURE RELIEF DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Duro Dyne Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Ruskin Company.
 - 6. Vent Products Company, Inc.
 - 7. Or approved equivalent.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm
- D. Maximum System Pressure: 1-inch wg
- E. Frame: 0.052-inch- thick, galvanized sheet steel or 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.
- F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
 - 1. Material: galvanized steel, plated steel or aluminum, mechanically attached to blade.
 - 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum or Galvanized steel.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball or synthetic pivot bushings.

2.3 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.

- d. Ruskin Company.
 - e. Vent Products Company, Inc.
 - f. Greenheck.
 - g. Lloyd Industries.
 - h. Or approved equivalent.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames:
 - a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:
 - a. Single blade up to 6 inches blade width; multiple blades for width over 6 inches.
 - b. Opposed-blade design for multiple blades dampers.
 - c. Round or oval ducts: butterfly type.
 - d. Stiffen damper blades for stability.
 - e. Galvanized-steel, 0.064 inch thick.
 - 6. Blade Axles: Galvanized steel.
 - 7. Bearings:
 - a. Oil-impregnated bronze or Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - 8. Tie Bars and Brackets: Galvanized steel.
- B. Standard, Aluminum, Manual Volume Dampers:**
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. McGill AirFlow LLC.
 - d. Ruskin Company.
 - e. Vent Products Company, Inc.
 - f. Greenheck.
 - g. Lloyd Industries.
 - h. Or approved equivalent.
 - 2. Standard leakage rating, with linkage outside airstream.
 - 3. Suitable for horizontal or vertical applications.
 - 4. Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges for attaching to walls and flangeless frames for installing in ducts.
 - 5. Blades:

- a. Single blade up to 6 inches blade width; multiple blades for width over 6 inches.
 - b. Opposed-blade design for multiple blades dampers.
 - c. Stiffen damper blades for stability.
 - d. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 - e. Extruded-Aluminum Blades: 0.050-inch- thick extruded aluminum.
6. Blade Axles: Galvanized steel.
 7. Bearings:
 - a. Oil-impregnated bronze or Molded synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 8. Tie Bars and Brackets: Aluminum.

2.4 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Duro Dyne Inc.
 4. McGill AirFlow LLC.
 5. Ruskin Company.
 6. Vent Products Company, Inc.
 7. Young Regulator Company.
 8. Greenheck.
 9. Or approved equivalent.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
 1. Hat shaped.
 2. Extruded Aluminum Channel, 0.125 inch thick.
 3. Reinforced corners.
- D. Blades:
 1. Multiple blades with maximum blade width of 8 inches.
 2. Parallel -blade design.
 3. Extruded Aluminum.
 4. 0.125 inch thick.
 5. Blade Edging: Closed-cell neoprene edging.
- E. Blade Axles: 1/2-inch- diameter; hex-shaped Plated steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Molded synthetic.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

2.5 FIRE DAMPERS

A. Manufacturers:

1. Greenheck.
2. McGill AirFlow Corporation.
3. Nailor Industries Inc.
4. Ruskin Company.
5. Lloyd Industries.
6. Or approved equivalent.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours.

D. Provide only dynamic type dampers.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Minimum Thickness: Same gauge as duct thick and of length to suit application.
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.

G. Mounting Orientation: Vertical or horizontal as indicated.

H. Blades: Roll-formed, interlocking, 0.034-inch thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch thick, galvanized-steel blade connectors.

I. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

J. Fusible Links: Replaceable, 165 deg F rated.

2.6 SMOKE DAMPERS

A. Manufacturers:

1. Greenheck Fan Corporation.

2. Nailor Industries Inc.
 3. Ruskin Company.
 4. Or approved equivalent.
- B. General Requirements: Label according to UL 555S by an NRTL.
- C. Smoke Detector: Loose for field-installation in ductwork within 5'-0" of damper.
- D. Frame: Hat-shaped, 0.094-inch- thick, galvanized sheet steel, with interlocking, gusseted corners, and mounting flange.
- E. Blades: Roll-formed, airfoil, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.
- F. Seals: Blade edge seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges. Jamb shall be constructed of flexible stainless steel compression type seals.
- G. Leakage: Class I.
- H. Pressure and Velocity Rating: 4" w.c. and 2000 FPM.
- I. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- J. Damper Motors: Two-position action.
- K. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."
 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 4. 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. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 5. Outdoor Motors and Motors in Outdoor-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.
 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 7. Electrical Connection: 115 V, single phase, 60 Hz.
- L. Accessories:
1. Auxiliary switches for fan control or position indication.

2. Test and reset switches, damper mounted (if accessible), remote mounted (if inaccessible).

2.7 COMBINATION FIRE AND SMOKE DAMPERS

- A. Manufacturers:
 1. Greenheck Fan Corporation.
 2. Nailor Industries Inc.
 3. Ruskin Company.
 4. Or approved equivalent.
- B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.
- D. Fire Rating: 1-1/2 hours.
- E. Frame: Hat-shaped, 0.063-inch- thick, galvanized sheet steel, with interlocking, gusseted corners, and mounting flange.
- F. Heat-Responsive Device: Resettable, 350 deg F rated, fire-closure device.
- G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.
- H. Smoke Detector: Loose for field-installation in ductwork within 5'-0" of damper.
- I. Blades: Roll-formed, airfoil, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.
- J. Seals: Blade edge seals shall be extruded silicone rubber permanently bonded to the appropriate blade edges. Jamb shall be constructed of flexible stainless steel compression type seals.
- K. Leakage: Class I.
- L. Rated pressure and velocity to exceed design airflow conditions.
- M. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- N. Damper Motors: Two-position action.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230900 "Instrumentation and Control for HVAC."

3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
4. 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. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
5. Outdoor Motors and Motors in Outdoor-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.
6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
7. Electrical Connection: 115 V, single phase, 60 Hz.

P. Accessories:

1. Auxiliary switches for fan control or position indication.
2. Test and reset switches, damper mounted (if accessible), remote mounted (if inaccessible).

2.8 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Ductmate Industries, Inc.
3. McGill AirFlow LLC.
4. Pottorff; a division of PCI Industries, Inc.
5. Ventfabrics, Inc.
6. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
7. Elgen.
8. Or approved equivalent.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Sheet metal, to match duct material, with insulation fill and thickness as indicated for duct pressure class.
 - c. Hinges and Latches: 2-by-2-inch butt or piano hinge and cam latches.
 - d. Fabricate doors airtight and suitable for duct pressure class.
 - e. Size: Not less than 16 inches by 14 inches. Ducts less than 16 inches in height, install with one dimension 16 inches and other dimension 2 inches less than duct width. Install larger sized doors where required for access.
2. Frame: Same material as door, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

- a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
- b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
- c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
- d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.9 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Flame Gard, Inc.
 3. 3M.
 4. Acudor.
 5. Or approved equivalent.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
 5. Or approved equivalent.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 30 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 30 oz./sq. yd.
2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 FLEXIBLE DUCTS

A. Manufacturers:

1. Type 1M by Flexmaster U.S.A., Inc.
2. Thermaflex Type MK-E by Flexible Technologies, Inc
3. Hart & Cooley, Inc.
4. McGill AirFlow Corporation.
5. Or approved equivalent.

B. Acoustical Insulated Steel Spiral Type:

1. Comply with SMACNA HVAC Flexible Duct Construction Standards and NFPA 90A.
2. Construct ducts of corrosion-resistant spunbound nylon fabric, mechanically locked to the duct helix without the use of adhesives. Duct helix shall be made of corrosion resistant galvanized steel. Vapor barrier shall be fire retardant, reinforce aluminum.
3. Duct shall be factory-insulated with a fiberglass blanket covered with a flame-resistant low permeability metalized vapor barrier jacket. Thermal conductivity of the insulation shall not exceed 0.23 (BTU) (inch)/(hour) (square foot) (degree F) at 75 degrees F mean temperature.

4. The internal working pressure rating shall be at least 6 inches w.g. positive and 5 inches w.g. negative up to 16" dia.
5. The flexible duct assembly shall carry UL 181, Class 1 air duct label.
6. Maximum length shall be 8 feet or less, as dictated by codes. The remainder shall be galvanized sheet metal. Provide flexible duct runs as straight as possible. Provide a minimum installed length of 5 feet at each air terminal.
7. Flexible duct insulation R-values shall meet or exceed ASHRAE-90.1-2019 requirements.

C. Flexible Duct Attachment Types:

1. Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 through 18 inches to suit duct size.
2. Flexible nylon straps with a minimum 175 pound tensile strength.

2.12 WIRE MESH GRILLES

- A. Construction: 1/2 inch (12.5 mm) mesh screen with 1 inch (2.5 mm) sheet metal frame, bolted to flanged duct connection.
- B. Materials:
 1. Screen: Minimum 18 gauge galvanized steel.
 2. Frame: Minimum 0.040 inch (1.02 mm) thick galvanized sheet steel.
 3. Bolts and nuts: Indoors, galvanized steel; exposed to weather, stainless steel.

2.13 DUCT 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 of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft and control dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Fire, Smoke and Combination Fire and Smoke Dampers:
 - 1. Install dampers in accordance with manufacturer's UL Installation Instructions, labeling, and NFPA 90A at locations indicated on the drawings. Any damper installation that is not in accordance with the manufacturer's UL Installation Instructions must be approved prior to installation.
 - 2. Dampers must be accessible to allow inspection, adjustment, and replacement of components. The sheet metal contractor shall furnish any access doors in ductwork or plenums required to provide this access. The general contractor shall furnish any access doors required in walls, ceilings, or other general building construction.
 - 3. Install dampers square and free from racking.
 - 4. The installing contractor shall provide and install bracing for multiple section assemblies to support assembly weight and to hold against system pressure.
 - 5. Do not compress or stretch the damper frame into the duct or opening.
 - 6. Attach multiple damper section assemblies together in accordance with manufacturer's instructions. Install support mullions as reinforcement between assemblies as required.
 - 7. Handle dampers using the frame or sleeve. Do not lift or move dampers using blades, actuator, or jackshaft.
- E. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts and as indicated. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install volume dampers at the following locations:
 - a. Where indicated on drawings and in details.
 - b. Where required for balancing.
 - 2. Install steel volume dampers in steel ducts.
 - 3. Install aluminum volume dampers in aluminum ducts.
- F. Set dampers to fully open position before testing, adjusting, and balancing.
- G. Install test holes at fan inlets and outlets and elsewhere as indicated and in ductwork where required for testing and adjusting.
- H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. For Fire Dampers and Combination Fire-Smoke Dampers.
 - 2. For Grease Ducts with applicable Grease Access Doors in accordance with the IMC 2018.

- I. Install access doors with swing against duct static pressure.
- J. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
- K. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- L. Install flexible connectors at duct connections to equipment, at building expansion joints, at connections between ducts of dissimilar metals and at penetrations of mechanical equipment room walls.
 - 1. Install flexible connections with 2 inches slack in fabric and minimum movement of 1 inch.
- M. Install duct test holes where required for testing and balancing purposes.
- N. Install wire mesh screen grilles at refrigerant exhaust air ducts and in other places where indicated. Bolt grilles to flanged connections or ducts at terminations.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Inspect turning vanes for proper and secure installation.
 - 4. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300