

**SECTION 23 33 00  
AIR DUCT ACCESSORIES**

**SECTION 23 33 00  
AIR DUCT CONNECTED ACCESSORIES**

**PART 1 GENERAL**

**1.01 REFERENCE STANDARDS**

- A. AMCA 500-D - Laboratory Methods of Testing Dampers for Rating; 2018.
- B. ASTM A480/A480M - Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip; 2025b.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2024.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems; 2024.
- G. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Current Edition, Including All Revisions.
- H. UL 555 - Standard for Fire Dampers; Current Edition, Including All Revisions.
- I. UL 555C - Standard for Safety Ceiling Dampers; Current Edition, Including All Revisions.
- J. UL 555S - Standard for Smoke Dampers; Current Edition, Including All Revisions.

**THE CONTRACTOR IS REFERRED TO THE “SPECIAL NOTICE TO CONTRACTORS SUMMARY FORM “ , THE “FORM OF PROPOSAL”; THE “FORM OF BID BOND”; “DIVISION 1 - GENERAL” OF THE “CONTRACT SPECIFICATIONS”; THE “CONTRACT DRAWINGS” AND ALL AMENDMENTS AND ADDENDA THERETO; ALL OF WHICH GOVERN THE WORK OF THIS SECTION.**

**1.02 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including contract drawings, General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
  
- B. Air Handling Units
- C. Metal Ducts
- D. Flexible Ducts

**1.03 SUMMARY**

- A. Section Includes:
  - 1. Backdraft and pressure relief dampers.
  - 2. Manual volume dampers.
  - 3. Control dampers.
  - 4. Fire dampers.
  - 5. Combination fire and smoke dampers.
  - 6. Flange connectors.
  - 7. Turning vanes.

8. Remote damper operators.
  9. Duct-mounted access doors.
  10. Flexible connectors.
  11. Flexible ducts.
  12. Duct accessory hardware.
- B. Related Sections:
1. Division 23 Section "HVAC roof mounted Ventilators", and roof-mounted ventilator enclosures as indicated on drawing schedule.
  2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

#### **1.04 SUBMITTALS**

- A. Product Data: For each type of product indicated.
1. For duct insulation , include manufacturer, required type, and thickness as .specified in related sections
- 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. Fire-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
    - e. Duct security bars.
    - f. 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.

#### **1.05 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.

#### **1.06 EXTRA MATERIALS**

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

### **PART 2 PRODUCTS**

#### **2.01 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 A653/A653M.
  - 1. Galvanized Coating Designation: G90 (Z275).
  - 2. Exposed-Surface Finish: Mill phosphatized.
- C. Stainless-Steel Sheets: Comply with ASTM A480/A480M, Type 304, and having a No. 2 finish for concealed ducts and No. 4 finish for exposed ducts.
- D. Aluminum Sheets: Comply with ASTM B 209 (ASTM B 209M), Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- E. Extruded Aluminum: Comply with ASTM B221 ((ASTM B221M)), 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 lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

## **2.02 BACKDRAFT AND PRESSURE RELIEF DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - 1. Air Balance Inc.; a division of Mestek, Inc.
  - 2. American Warming and Ventilating; a division of Mestek, Inc.
  - 3. Cesco Products; a division of Mestek, Inc.
  - 4. Duro Dyne Inc.
  - 5. Greenheck Fan Corporation.
  - 6. Lloyd Industries, Inc.
  - 7. NCA Manufacturing, Inc.
  - 8. Pottorff; a division of PCI Industries, Inc.
  - 9. Ruskin Company.
  - 10. SEMCO Incorporated.
  - 11. Vent Products Company, Inc.
- B. Description: back draft, volume damper balancing, opposed blade balanced, and or motor operated control damper.
- C. Maximum Air Velocity: 2000 fpm
- D. Maximum System Pressure: 2-inch wg
- E. Frame: 0.052-inch-thick, galvanized sheet steel, 0.063-inch- thick, extruded aluminum 0.052-inch-thick and or stainless steel, 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, noncombustible, tear-resistant, neoprene-coated fiberglass with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Vinyl foam or Neoprene, mechanically locked.
- I. Blade Axles:
  - 1. Material: Galvanized steel or Stainless steel
  - 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
- M. Accessories:

1. Adjustment device to permit setting for varying differential static pressure.
  2. Counterweights and spring-assist kits for vertical airflow installations.
  3. Electric actuators.
  4. Chain pulls.
  5. Front of rear screens.
  6. 90-degree stops.
- N. Sleeve: Minimum 18-gage thickness.

### **2.03 MANUAL VOLUME DAMPERS**

- A. Low-Leakage, Steel, Manual Volume Dampers:
1. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    - a. Air Balance Inc.; a division of Mestek, Inc.
    - b. American Warming and Ventilating; a division of Mestek, Inc.
    - c. Flexmaster U.S.A., Inc.
    - d. McGill AirFlow LLC.
    - e. METALAIRE, Inc.
    - f. Nailor Industries Inc.
    - g. Pottorff; a division of PCI Industries, Inc.
    - h. Ruskin Company.
    - i. Trox USA Inc.
    - j. Vent Products Company, Inc.
  2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
  3. Suitable for horizontal or vertical applications.
  4. Frames:
    - a. Angle shaped.
    - b. Galvanized or Stainless-steel channels, 0.064 inch thick.
    - c. Mitered and welded corners.
    - d. Flanges for attaching to walls and flangeless frames for installing in ducts.
  5. Blades:
    - a. Multiple or single blade.
    - b. Parallel- or opposed-blade design.
    - c. Stiffen damper blades for stability.
    - d. Galvanized or Stainless, roll-formed steel, 0.064 inch thick.
  6. Blade Axles: Galvanized steel or Stainless steel
  7. Bearings:
    - a. 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. Blade Seals: Vinyl or Neoprene.
  9. Jamb Seals: Cambered stainless steel
  10. Tie Bars and Brackets: Galvanized steel or Aluminum.
  11. Accessories:
    - a. Include locking device to hold single-blade dampers in a fixed position without vibration.
- B. Jackshaft:
1. Size: 1-inch diameter.
  2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
  3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

- C. Damper Hardware:
  - 1. 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.
  - 2. Include center hole to suit damper operating-rod size.
  - 3. Include elevated platform for insulated duct mounting.
  - 4.

## **2.04 CONTROL DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the work include, but are not limited to, the following:
  - 1. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Arrow United Industries; a division of Mestek, Inc.
  - 3. Cesco Products; a division of Mestek, Inc.
  - 4. Duro Dyne Inc.
  - 5. Flexmaster U.S.A., Inc.
  - 6. Greenheck Fan Corporation.
  - 7. Lloyd Industries, Inc.
  - 8. M&I Air Systems Engineering; Division of M&I Heat Transfer Products Ltd.
  - 9. McGill AirFlow LLC.
  - 10. METALAIRE, Inc.
  - 11. Metal Form Manufacturing, Inc.
  - 12. Nailor Industries Inc.
  - 13. NCA Manufacturing, Inc.
  - 14. Ruskin Company.
  - 15. Vent Products Company, Inc.
  - 16. Young Regulator Company.
- 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. Angle shaped.
  - 2. Galvanized or Stainless-steel channels, 0.064 inch thick.
  - 3. Mitered and welded corners.
- D. Blades:
  - 1. Multiple blade with maximum blade width of 8 inches.
  - 2. Parallel- and Opposed-blade design.
  - 3. Galvanized or Stainless steel.
  - 4. 0.064 inch thick.
  - 5. Blade Edging: Closed-cell neoprene edging.
  - 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch- diameter; galvanized steel or stainless 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. Stainless-steel sleeve.
  - 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.
  - 3. Thrust bearings at each end of every blade.

## **2.05 FIRE DAMPERS**

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Air Balance Inc.; a division of Mestek, Inc.
  2. Arrow United Industries; a division of Mestek, Inc.
  3. Cesco Products; a division of Mestek, Inc.
  4. Greenheck Fan Corporation.
  5. McGill AirFlow LLC.
  6. METALAIRE, Inc.
  7. Nailor Industries Inc.
  8. NCA Manufacturing, Inc.
  9. PHL, Inc.
  10. Pottorff; a division of PCI Industries, Inc.
  11. Prefco; Perfect Air Control, Inc.
  12. Ruskin Company.
  13. Vent Products Company, Inc.
  14. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Type: Static and dynamic; rated and labeled according to UL 555 by an NRTL.
- C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours to match fire rating of penetration
- E. Frame: Curtain type with blades inside airstream, Multiple-blade type, including when located behind grille where blades may be inside 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: 0.052 or 0.138 inch thick, as indicated, and of length to suit application.
  2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply 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. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- K. Heat-Responsive Device: Electric resettable link and switch package, factory installed, 165 deg F rated.

## **2.06 CEILING 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. Cesco Products; a division of Mestek, Inc.
  3. McGill AirFlow LLC.
  4. METALAIRE, Inc.
  5. Nailor Industries Inc.
  6. Prefco; Perfect Air Control, Inc.
  7. Ruskin Company.
  8. Vent Products Company, Inc.
  9. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. General Requirements:
1. Labeled according to UL 555C by an NRTL.

2. Comply with construction details for tested floor- and roof-ceiling assemblies as indicated in UL's "Fire Resistance Directory."
- C. Frame: Galvanized sheet steel, round or rectangular, style to suit ceiling construction.
  - D. Blades: Galvanized sheet steel with refractory insulation.
  - E. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
  - F. Fire Rating: 2 and 3 hours.

## **2.07 COMBINATION FIRE AND SMOKE DAMPERS**

- A. Manufacturers: Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Air Balance Inc.; a division of Mestek, Inc.
  2. Cesco Products; a division of Mestek, Inc.
  3. Greenheck Fan Corporation.
  4. Nailor Industries Inc.
  5. Ruskin Company.
- B. Type: Static and 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 4000-fpm velocity.
- D. Fire Rating: 1-1/2 and 3 hours.
- E. Frame: Curtain type with blades inside airstream, including when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- F. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.
- G. Heat-Responsive Device: Electric resettable link and switch package, factory installed, rated.
- H. Smoke Detector: Integral, factory wired for single-point connection.
- I. Frame: Curtain type with blades inside airstream, including when located behind grille where blades may be inside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.
- J. Blades: Roll-formed, horizontal, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.
- K. Leakage: Class I
- L. Rated pressure and velocity to exceed design airflow conditions.
- M. Mounting Sleeve: Factory-installed, 0.052-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone caulking.
- N. Master control panel for use in dynamic smoke-management systems.
- O. Damper Motors: Modulating and two-position action.
- P. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 ."
  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 Division 23 Section "Control for HVAC." Division 26 Sections.
  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 inch. 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. Electrical Connection: 115 V, single phase, 60 Hz.

Q. Accessories:

1. Auxiliary switches for signaling, fan control and position indication].
2. Momentary test switch, Test and reset switches, and damper, remote mounted.

## 2.08 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
  1. Ductmate Industries, Inc.
  2. Nexus PDQ; Division of Shilco Holdings Inc.
  3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

## 2.09 TURNING VANES

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Duro Dyne Inc.
  2. METALAIRE, Inc.
  3. SEMCO Incorporated.
  4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
  1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."
- E. Vane Construction: Single wall.
- F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

## 2.10 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  1. Pottorff; a division of PCI Industries, Inc.
  2. Ventfabrics, Inc.
  3. Young Regulator Company.

- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Brass.
- D. Cable: Stainless steel.
- E. Wall-Box Mounting: Recessed, 3/4 inches deep
- F. Wall-Box Cover-Plate Material: Stainless steel.

## 2.11 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. American Warming and Ventilating; a division of Mestek, Inc.
  - 2. Cesco Products; a division of Mestek, Inc.
  - 3. Ductmate Industries, Inc.
  - 4. Flexmaster U.S.A., Inc.
  - 5. Greenheck Fan Corporation.
  - 6. McGill AirFlow LLC.
  - 7. Nailor Industries Inc.
  - 8. Pottorff; a division of PCI Industries, Inc.
  - 9. Ventfabrics, Inc.
  - 10. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 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. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
    - c. Vision panel.
    - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
    - e. Fabricate doors airtight and suitable for duct pressure class.
  - 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
  - 3. Number of Hinges and Locks:
    - a. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
    - b. Access Doors up to 24 by 48 Inches : Three hinges and two compression latches with outside and inside handles.
    - c. Access Doors Larger Than 24 by 48 Inches : Four hinges and two compression latches with outside and inside handles.
- C. Pressure Relief Access Door:
  - 1. Door and Frame Material: Galvanized sheet steel.
  - 2. Door: Single wall and Double wall with insulation fill with metal thickness applicable for duct pressure class.
  - 3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
  - 4. Factory set at 10-inch wg
  - 5. Doors close when pressures are within set-point range.
  - 6. Hinge: Continuous piano.
  - 7. Latches: Cam.
  - 8. Seal: Neoprene or foam rubber.
  - 9. Insulation Fill: 1-inch-thick, fibrous-glass or polystyrene-foam board.

## 2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Ductmate Industries, Inc.
  - 2. Duro Dyne Inc.
  - 3. Ventfabrics, Inc.
  - 4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- 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: 26 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: 24 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. High-Corrosive-Environment System, Flexible Connectors: Glass fabric with chemical-resistant coating.
  - 1. Minimum Weight: 14 oz./sq. yd.
  - 2. Tensile Strength: 450 lbf/inch in the warp and 340 lbf/inch in the filling.
  - 3. Service Temperature: Minus 67 to plus 500 deg F.

## 2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, Available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
  - 1. Flexmaster U.S.A., Inc.
  - 2. McGill AirFlow LLC.
  - 3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 10 to plus 160 deg F.
- C. Noninsulated, Flexible Duct: UL 181, Class 1, black polymer film supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 4-inch wg positive and 0.5-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 175 deg F (Minus 29 to plus 79 deg C).
- D. Noninsulated, Flexible Duct: UL 181, Class 1, multiple layers of aluminum laminate supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F.

- E. Noninsulated, Flexible Duct: UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound, spring-steel wire.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm.
  - 3. Temperature Range: Minus 20 to plus 210 deg F
- F. Noninsulated, Flexible Duct: UL 181, Class 0, interlocking spiral of aluminum foil.
  - 1. Pressure Rating: 8-inch wg positive or negative.
  - 2. Maximum Air Velocity: 5000 fpm .
  - 3. Temperature Range: Minus 100 to plus 435 deg F .
- G. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; aluminized vapor-barrier film.
  - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
  - 2. Maximum Air Velocity: 4000 fpm
  - 3. Temperature Range: Minus 10 to plus 160 deg F
- H. Flexible Duct Connectors:
  - 1. Clamps: 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. Non-Clamp Connectors: Liquid adhesive plus tape or Adhesive plus sheet metal screws.

#### **2.14 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**

#### **3.01 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 dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. 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. Coordinate subparagraphs below with Division 23 Section "Metal Ducts." Install steel volume dampers in steel ducts.
  - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire, fire and smoke dampers according to UL listing.
- H. Install duct security bars. Construct duct security bars from 0.164-inch steel sleeve, continuously welded at all joints and 1/2-inch-diameter steel bars, 6 inches o.c. in each direction in center of sleeve. Weld each bar to steel sleeve and each crossing bar. Weld 2-1/2-

by-2-1/2-by-1/4-inch steel angle to 4 sides and both ends of sleeve. Connect duct security bars to ducts with flexible connections. Provide 12-by-12-inch hinged access panel with cam lock in duct in each side of sleeve.

- I. Connect all ducts to equipment with flexible duct connectors.
- J. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
  - 1. On both sides of duct coils.
  - 2. Downstream from manual volume dampers, control dampers, turning vanes, and equipment.
  - 3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
  - 4. At each change in direction and at maximum 50-foot spacing.
  - 5. Upstream of turning vanes.
  - 6. Elsewhere as indicated.
- K. Install access doors with swing against duct static pressure.
- L. Access Door Sizes:
  - 1. One-Hand or Inspection Access: 8 by 5 inches.
  - 2. Two-Hand Access: 12 by 6 inches.
  - 3. Head and Hand Access: 18 by 10 inches.
  - 4. Head and Shoulders Access: 21 by 14 inches.
  - 5. Body Access: 25 by 14 inches.
  - 6. Body plus Ladder Access: 25 by 17 inches
- M. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.
- N. Install flexible connectors to connect ducts to equipment.
- O. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
- P. Connect diffusers or light troffer boots to low-pressure ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with liquid adhesive plus tape or adhesive plus sheet metal screws.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

### **3.02 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. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
  - 4. Inspect turning vanes for proper and secure installation. Operate remote damper operators to verify full range of movement of operator and damper

**END OF SECTION 23 33 00**

a.