

## SECTION 15815

### METAL DUCTS

#### PART 1 - GENERAL

##### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section

##### 1.2 SUMMARY

###### A. Section Includes

1. Single-wall rectangular ducts and fittings
2. Single-wall round ducts and fittings
3. Sheet metal materials
4. Duct liner
5. Sealants and gaskets
6. Hangers and supports

###### B. Material Requirements

1. Refer to Drawings for materials required for corrosive conditions in exposure to domestic wastewater environment

##### 1.3 ACTION SUBMITTALS

###### A. Product Data: For each type of the following products

1. Liners and adhesives
2. Sealants and gaskets

#### PART 2 - PRODUCTS

##### 2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

## 2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following
  - 1. Lindab Inc.
  - 2. McGill AirFlow LLC.
  - 3. SEMCO Incorporated.
  - 4. Spiral Manufacturing Co., Inc.
- C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"

## 2.3 SHEET METAL MATERIALS

- A. General Material Requirements: 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: G60 (Z180)
  - 2. Finishes for surfaces exposed to view: Mill phosphatized
- C. Aluminum Sheets: Comply with ASTM B209 (ASTM B209M) Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view
- D. Reinforcement Shapes and Plates: ASTM A36/A36M, steel plates, shapes, and bars; black and galvanized
  - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials
- E. Tie Rods: Galvanized steel, 1/4-inch (6-mm) minimum diameter for lengths 36 inches (900 mm) or less; 3/8-inch (10-mm) minimum diameter for lengths longer than 36 inches (900 mm)

## 2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard"
  - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following
    - a. CertainTeed Corporation; Insulation Group
    - b. Johns Manville
    - c. Knauf Insulation
    - d. Owens Corning
    - e. Maximum thermal conductivity
      - 1) Type I, flexible: 0.27 Btu x in./h x sq. ft. x deg F (0.039 W/m x K) at 75 deg F (24 deg C) mean temperature
  - 2. Antimicrobial erosion-resistant coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems
  - 3. Water-based liner adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C916
    - a. For indoor applications, adhesive shall have a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24)
- B. Insulation Pins and Washers
  - 1. Cupped-head, capacitor-discharge-weld pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- (2.6-mm-)

- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch (38-mm) galvanized carbon-steel washer
2. Insulation-retaining washers: Self-locking washers formed from 0.016-inch (0.41-mm-) thick aluminum; with beveled edge sized as required to hold insulation securely in place but not less than 1½ inches (38 mm) in diameter
- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation"
1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited
  2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing
  3. Butt transverse joints without gaps, and coat joint with adhesive
  4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping
  5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary
  6. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally
  7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations
    - a. Fan discharges
    - b. Intervals of lined duct preceding unlined duct

## 2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL
- B. Water-Based Joint and Seam Sealant
1. Application method: Brush on
  2. Solids content: Minimum 65 percent
  3. Shore A hardness: Minimum 20
  4. Water resistant
  5. Mold and mildew resistant
  6. VOC: Maximum 75 g/L (less water)
  7. Maximum static-pressure class: 10-inch wg (2500 Pa), positive and negative
  8. Service: Indoor or outdoor
  9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets

- C. Flanged Joint Sealant: Comply with ASTM C920
  - 1. General: Single-component, acid-curing, silicone, elastomeric
  - 2. Type: S
  - 3. Grade: NS
  - 4. Class: 25
  - 5. Use: O
- D. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer
- E. Round Duct Joint O-Ring Seals
  - 1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg (0.14 L/s per sq. m at 250 Pa) and shall be rated for 10-inch wg (2500-Pa) static-pressure class, positive or negative
  - 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot
  - 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots

## 2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation
- B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct"
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials
- D. Trapeze and Riser Supports
  - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates
  - 2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates
  - 3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate

## PART 3 - EXECUTION

### 3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings

- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated
- C. Install round ducts in maximum practical lengths
- D. Install ducts with fewest possible joints
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building
- H. Install ducts with a clearance of 1 inch (25 mm), plus allowance for insulation thickness
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches (38 mm)
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 15 Section "Duct Accessories" for fire and smoke dampers
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines"

### 3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets

- E. Repair or replace damaged sections and finished work that does not comply with these requirements

### 3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
  - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"
  - 2. Outdoor, supply-air ducts: Seal Class A
  - 3. Unconditioned space, supply-air ducts in pressure classes 2-inch wg (500 pa) and lower: Seal Class B
  - 4. Unconditioned space, supply-air ducts in pressure classes higher than 2-inch wg (500 Pa): Seal Class A
  - 5. Unconditioned space, exhaust ducts: Seal Class C
  - 6. Unconditioned space, return-air ducts: Seal Class B
  - 7. Conditioned space, supply-air ducts in pressure classes 2-inch wg (500 pa) and lower: Seal Class C
  - 8. Conditioned space, supply-air ducts in pressure classes higher than 2-inch wg (500 Pa): Seal Class B
  - 9. Conditioned space, exhaust ducts: Seal Class B
  - 10. Conditioned space, return-air ducts: Seal Class C

### 3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports"
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached
  - 1. Where practical, install concrete inserts before placing concrete
  - 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured
  - 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches (100 mm) thick
  - 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches (100 mm) thick
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1 (Table 5-1M), "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches (610 mm) of each elbow and within 48 inches (1200 mm) of each branch intersection

- D. Hangers Exposed to View: Threaded rod and angle or channel supports
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet (5 m)
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used

### 3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Division 15 Section "Duct Accessories"
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections

### 3.6 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 9 painting Sections

### 3.7 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing
- B. Use service openings for entry and inspection
  - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Division 15 Section "Duct Accessories" for access panels and doors
  - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection
  - 3. Remove and reinstall ceiling to gain access during the cleaning process
- C. Particulate Collection and Odor Control
  - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles
  - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building
- D. Clean the following components by removing surface contaminants and deposits



1. Air outlets and inlets (registers, grilles, and diffusers)
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains
4. Coils and related components
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms
6. Supply-air ducts, dampers, actuators, and turning vanes
7. Dedicated exhaust and ventilation components and makeup air systems

#### E. Mechanical Cleaning Methodology

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins
6. Provide drainage and cleanup for wash-down procedures
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris

### 3.8 STARTUP

- A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing."

### 3.9 DUCT SCHEDULE

#### A. Supply Ducts

1. Ducts connected to fan coil units, furnaces, heat pumps, and terminal units
  - a. Pressure Class: Positive 2-inch wg (500 Pa)
2. Ducts connected to constant-volume air-handling units
  - a. Pressure class: Positive 2-inch wg (500 Pa)
3. Ducts connected to variable-air-volume air-handling units

- a. Pressure class: Positive 4-inch wg (1000 Pa)
- 4. Ducts connected to equipment not listed above
  - a. Pressure class: Positive 2-inch wg (500 Pa)

#### B. Return Ducts

- 1. Ducts connected to fan coil units, furnaces, heat pumps, and terminal units
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)
- 2. Ducts connected to air-handling units
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)
- 3. Ducts connected to equipment not listed above
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)

#### C. Exhaust Ducts

- 1. Ducts connected to fans exhausting (ASHRAE 62.1, Class 1 and 2) air
  - a. Pressure class: Negative 2-inch wg (500 Pa)
- 2. Ducts connected to air-handling units insert equipment
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)
- 3. Ducts connected to fans exhausting laboratory and process (ASHRAE 62.1, Class 3 and 4) air
  - a. Type 316, stainless-steel sheet
    - 1) Exposed to View: No. 4 finish
    - 2) Concealed: No. 2B finish
  - b. PVC-coated, galvanized sheet steel with thicker coating on duct interior
  - c. Pressure class: Positive or negative 4-inch wg (1000 Pa)
  - d. Minimum SMACNA seal class: Welded seams, joints, and penetrations
- 4. Ducts connected to equipment not listed above
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)

#### D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts

- 1. Ducts connected to fan coil units, furnaces, heat pumps, and terminal units  
Insert equipment
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)
- 2. Ducts connected to air-handling units
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa)
- 3. Ducts connected to equipment not listed above
  - a. Pressure class: Positive or negative 2-inch wg (500 Pa) .

#### E. Liner

- 1. Supply air ducts: Fibrous glass, Type I, 1 inch (25 mm) thick
- 2. Return air ducts: Fibrous glass, Type I, 1 inch (25 mm) thick
- 3. Exhaust air ducts: Fibrous glass, Type I, 1 inch (25 mm) thick
- 4. Transfer ducts: Fibrous glass, Type I, 1 inch (25 mm) thick

#### F. Elbow Configuration

- 1. Rectangular duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows"

- a. Velocity 1000 fpm (5 m/s) or lower
    - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio
    - 2) Mitered Type RE 4 without vanes
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s)
    - 1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio
    - 2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows"
  - c. Velocity 1500 fpm (7.6 m/s) or higher
    - 1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio
    - 2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes
    - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows"
2. Rectangular duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows"
    - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio
    - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes
    - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows"
  3. Round duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbow."
    - a. Minimum radius-to-diameter ratio and elbow segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments
      - 1) Velocity 1000 fpm (5 m/s) or lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow
      - 2) Velocity 1000 to 1500 fpm (5 to 7.6 m/s): 1.0 radius-to-diameter ratio and four segments for 90-degree elbow
      - 3) Velocity 1500 fpm (7.6 m/s) or higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow
      - 4) Radius-to diameter ratio: 1.5
  4. Round elbows, 12 inches (305 mm) and smaller in diameter: Stamped or pleated
  5. Round elbows, 14 inches (356 mm) and larger in diameter: Welded

#### G. Branch Configuration

1. Rectangular duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection"
  - a. Rectangular main to rectangular branch: 45-degree entry
  - b. Rectangular main to round branch: Spin in

2. Round and flat oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct
  - a. Velocity 1000 fpm (5 m/s) or lower: 90-degree tap
  - b. Velocity 1000 to 1500 fpm (5 to 7.6 m/s): Conical tap
  - c. Velocity 1500 fpm (7.6 m/s) or higher: 45-degree lateral

END OF SECTION 15815