DIVISION 15 MECHANICAL
SECTION 15841 LOW-VELOCITY METAL DUCTWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Low-velocity ductwork is hereby defined to include work with velocities not exceeding 2000 fpm and static pressures not exceeding 2 inch water column.

B. The types of ductwork specified in this section include, but are not necessarily limited to the following:

1. Air conditioning supply and return air systems.
2. Fresh air supply systems.
3. Mechanical exhaust systems.

1.2 RELATED SECTIONS

A. Section 15010 – “Mechanical General Provisions”

B. Section 15860 – “Ductwork Accessories “ Fabricate ductwork with accessories installed during fabrication to the greatest extent possible.

1.3 QUALITY ASSURANCE

A. Codes: Installations shall comply with applicable sections of NFPA 90A, NFPA 96 and applicable Mechanical Code.

B. Industry Standards:

1. Comply with SMACNA recommendations for fabrication, construction and details, and installation procedures, except as otherwise indicated.
2. Comply with ASHRAE recommendations, except as otherwise indicated.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect shop fabricated ductwork, accessories and purchased products from damage during shipping, storage and handling. Prevent end damage and prevent dirt and moisture from entering ducts and fittings.

B. Where possible, store ductwork inside and protect from weather. Where necessary to store outside, store above grade and enclosed with waterproof wrapping.

PART 2 – PRODUCTS

2.1 DUCTWORK MATERIALS:

A. Sheet Metal, General: Provide sheet metal thicknesses indicated, packaged and marked as specified in ASTM A700. Where ductwork is indicated to be exposed to view, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, oil canning, stains and discolorations, and other imperfections, including those which would impair painting.

2. Stainless Steel Sheet: Where indicated, provide stainless steel complying with ASTM A 480; type 316, sheet form, with No. 4 finish where exposed to view. Protect finished surfaces with mill-applied adhesive protective paper, maintained through fabrication and installation.

2.2 MISCELLANEOUS DUCTWORK MATERIALS:
A. Provide miscellaneous materials and products of the types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

B. Duct Liner: N/A

C. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant (type applicable for the fabrication/installation detail) as compounded and recommended by the manufacturer specifically for sealing joints and seams in ductwork.

D. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.
   1. For exposed stainless steel ductwork, provide matching stainless steel support materials.

E. Duct Liner Adhesive: N/A

F. Duct Liner Fasteners: N/A

G. Flexible Ducts: Either spiral-wound spring steel with flame proof vinyl sheathing or corrugated aluminum; complying with UL181.
   1. Provide 1 inch thick continuous flexible fiberglass sheath with vinyl vapor barrier jacket.

2.3 ROUND AND OVAL DUCT:

A. Basic Round Diameter is the diameter of the size of round duct that has a circumference equal to the perimeter of a given size of flat oval duct. Except where interrupted by fittings, provide round and flat oval ducts in lengths not less than 12 feet.
   1. Fabricate Round Ductwork with spiral lockseam construction. Comply with SMACNA "HVAC Duct Construction Standards," Table 3-2 for galvanized steel gages.
   2. Where concealed from view Snap-Lock style of round ducting is acceptable.

B. Flat Oval Ducts: Fabricate flat oval supply ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gages listed in SMACNA "HVAC Duct Construction Standards," Table 3-4.


D. Diverging-Flow Fittings: Fabricate with a reduced entrance to branch taps with no excess material projecting from the body onto branch tap entrance.

E. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate the bend radius of die-formed, gored, and pleated elbows 1.5 times the elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements.
   1. Mitered Elbows: Fabricate mitered elbows with welded construction in gages specified below.
   2. Mitered Elbows Radius and Number of Pieces: Unless otherwise indicated, construct elbow to comply with SMACNA "HVAC Duct Construction Standards," Table 3-1.
   3. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from minus 2 inches to plus 2 inches:
      a. 3 to 26 inches: 24 gage
      b. 27 to 36 inches: 22 gage
      c. 37 to 50 inches: 20 gage
   4. Round Mitered Elbows: Solid welded and with metal thickness listed below for pressure classes from 2 inches to 10 inches:
      a. 3 to 14 inches: 24 gage
      b. 15 to 26 inches: 22 gage
      c. 27 to 50 inches: 20 gage
   5. Flat Oval Mitered Elbows: Solid welded and with the same metal thickness as longitudinal seam flat oval duct.
6. 90-Degree, 2-Piece, Mitered Elbows: Use only where space restrictions do not permit the use of 1.5 bend radius elbows. Fabricate with single-thickness turning vanes.

7. Round Elbows - 16 inch diameter or less may be "Snaplock" adjustable elbows constructed per SMACNA standards.

8. Round Elbows - 9 through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, except where space restrictions require a mitered elbow. Fabricate nonstandard bend angle configurations or 1/2-inch diameter (e.g., 9-1/2 and 10-1/2 inch) elbows with gored construction.

9. Round Elbows - Larger than 14 Inches and All Flat Oval Elbows: Gored elbows, except where space restrictions require a mitered elbow.

10. Die-Formed Elbows for Sizes through 8 Inches and All Pressures: 20 gage with 2-piece welded construction.

11. Round Gored Elbows Gages: Same as for non-elbow fittings specified above.

12. Flat Oval Elbows Gages: Same as longitudinal seam flat oval duct.

2.4 FABRICATION:

A. Shop fabricate ductwork in 4, 5, 8, 10 or 12-foot lengths, unless otherwise indicated or required to complete runs. Round Ducts lengths up to 20 feet may be used. Pre-assemble work in the shop to the greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to the extent necessary for shipping and handling. Match-mark sections for re-assembly and coordinated installation. Transverse duct joints may be made with "Ductmate System", "TDF Systems", and "TDC Systems". Ductmate System shall be fabricated and installed in accordance with manufacturer's recommendations.

B. Gages, Rectangular Ductwork: Fabricate steel ductwork (galvanized and stainless, if any) from the following minimum gages for the sizes up to the corresponding maximum long-side dimensions indicated:
   1. 26 gage up to 12 inch size.
   2. 24 gage up to 30 inch size.
   3. 22 gage up to 54 inch size.
   4. 20 gage up to 84 inch size.
   5. 18 gage for sizes larger than 84 inch.

C. Grease and Fume Exhaust Duct: Construct using 16 ga. galvanized material with welded seams in accordance with NFPA 96 and uniform mechanical code. Use stainless steel where exposed below ceilings. Galvanized sheet may be used in concealed areas.

D. Fabricate rectangular ductwork with joints, seams and reinforcements as indicated, complying with recognized industry standards.

E. Provide cross joints of the following types, limited to the maximum long-side dimension indicated (type is fabricator's option where more than one type is indicated):
   1. Drive-slip; up to 18 inch.
   2. Plain S-slip; up to 18 inch.
   3. Hemmed S-slip; up to 30 inch.
   4. Bar-slip; up to 60 inch.
   5. Pocket-lock; up to 60 inch.
   6. Alternate bar-slip (Standing S-slip); up to 84 inch.
   7. Reinforced bar-slip (cleat); up to 84 inch.
   8. Angle-slip; unlimited size.
   10. Angle-reinforced standing seam; unlimited size.
   11. Companion angles; unlimited size.
   12. Ductmate System (Ductmate Industries, Inc.)
   13. TDF System
   14. TDC System

F. Provide longitudinal seams of the following types, limited to the maximum long-side dimensions as indicated:
   1. Acme-lock; up to 30 inch in flat sides.
   2. Button-punch snap-lock; up to 84 inch, but not permitted for aluminum ductwork.
   3. Pittsburgh-lock; unlimited size.
G. Reinforce rectangular ductwork with angle frames as follows for the corresponding long-side dimensions, and space as indicated:
   1. Up to 18 inch; no reinforcing required.
   2. Up to 42 inch; 1 inch x 1 inch x 1/8 inch, 60 inch o.c. spacing.
   3. Up to 60 inch; 1-1/2 inch x 1-1/2 inch x 1/8 inch, 60 inch o.c. spacing.
   4. Up to 84 inch; 1-1/2 inch x 1-1/2 inch x 1/8 inch, 30 inch o.c. spacing.
   5. Up to 94 inch; 1-1/2 inch x 1-1/2 inch x 3/16 inch, 30 inch o.c. spacing.
   6. Above 94 inch; 2 inch x 2 inch x 1/4 inch, 30 inch o.c. spacing.

H. Crossbreaking: In addition to required reinforcement of rectangular ductwork, stiffen flat duct surfaces over 18 inch wide by crossbreaking; except do not crossbreak ducts indicated to receive external or internal rigid insulation.

I. Beading: Beading is an acceptable alternative to crossbreaking.

J. Fabricate external standing-seam ductwork with angle-reinforced standing seam cross joints for long-side dimensions over 60 inch; and for 60 inch and less, fabricate either with angle-reinforced standing-seam cross joints or standing seam cross joints. Fabricate longitudinal seams of Pittsburgh-locks or button-punch snap-locks.
   1. Provide standing seams of the following heights, limited to the maximum long-side dimensions as indicated:
      a. 1 inch height up to 42 inch.
      b. 1-1/2 height over 42 inch.
   2. Reinforce standing seams with angles as specified for ductwork reinforcement, except none required for 60 inch and less long-side dimension.
   3. Space cross joints as follows for the corresponding long-side dimensions:
      a. Up to 18 inch; 8 foot-0 inch o.c. spacing.
      b. Up to 30 inch; 5 foot-0 inch o.c. spacing.
      c. Up to 42 inch; 4 foot-0 inch o.c. spacing.
      d. Up to 60 inch; 3 foot-0 inch o.c. spacing.
      e. Over 60 inch; 2 foot-0 inch o.c. spacing.
   4. Where 4 sides of duct are fabricated with standing seams, alternate the seam locations between side and top/bottom seams. Fold over ends of standing seams and seal seam at corners with duct sealant, from inside the duct.

K. Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30 degrees for contracting tapers and 20 degrees for expanding tapers.

L. Fabricate ductwork with duct liner in each section of duct where required. Laminate liner to internal surfaces of duct in accordance with instructions by manufacturers of lining and adhesive, and fasten with mechanical fasteners. Coat all cut edges with adhesive to prevent erosion.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Assemble and install ductwork in accordance with recognized industry practices which will achieve air tight and noiseless systems, capable to performing each indicated service. Install each run with a minimum of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of the type which will hold ducts true-to-shape and to prevent buckling.

B. Ductwork on dining floor to be exposed spiral ducting and formed elbows cleaned and ready for painting.

C. Complete fabrication of work at the project as necessary to match shop fabricated work and accommodate installation requirements.

D. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations. Limit clearance to 0.5 inch where furring is
shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1.0 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate the layout with suspended ceiling and lighting layouts and similar finished work.

E. Electrical Equipment Spaces: Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.

F. Where ducts pass through interior partitions and exterior walls, conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct. Overlap the opening on all sides by at least 1-1/2 inch.

G. Where ducts pass through fire-rated floors, walls or partitions, provide firestopping between duct and substrate, and install fire dampers in accordance with their UL listing.

H. Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of the ductwork system.

I. Connect branch take-offs to include prefabricated air scoops.

J. Support ductwork from building structure as required and, where not otherwise indicated, anchor with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps or special beam clamps.

K. Support vertical ducts, at 12 feet on center spacing, by attachment to adjacent vertical structural surfaces or by direct bearing at floor penetrations and similar locations.
   1. Ducts up to 24 inch x 20 inch size, support with 1-1/2 inch x 16 gauge straps or formed angles.
   2. Ducts larger than 24 inch x 20 inch size, support with steel angle brackets; 1 inch x 1 inch x 1/8 inch
   3. Duct sizes up to 36 inch x 18 inch; 1-1/4 inch x 1-1/4 inch x 1/8 inch for larger sizes.

L. Support horizontal ducts located against structural walls and other similar adjacent vertical surfaces, at maximum 8 feet on center along run for round or oval ducts up to 40 inch horizontal dimension and maximum 4 feet on center spacing for larger ducts.

M. Hang horizontal rectangular ducts at maximum 8 feet on center along run for ducts up to 40 inch horizontal dimension and maximum 4 feet on center spacing for larger ducts.

3.2 DUCT SUPPORTS:

A. Rectangular ducts 16 inch and smaller:
   1. Use two strap hangers 1 inch x 22 gauge with two 5/16 inch screws on side of duct and one in bottom for each hanger.

B. Rectangular ducts 17 inch thru 36 inch:
   1. Use two strap hangers 1 inch x 18 gauge with two 5/16 inch screws on side of duct and one in bottom for each hanger.

C. Rectangular ducts 37 inch and Larger:
   1. All ducts 37 inch or larger shall be hung on trapeze hangers.

D. Round Ducts:
   1. Hanger spacing shall be no greater than 12 foot-0 inch on centers.

E. Minimum Hanger Size:
   1. Ducts 24; diameter and smaller shall be supported with either a 1/4 inch diameter rod or 1 inch x 22 gauge strap.
   2. Ducts 25 inch diameter and larger shall be supported with two 3/8 inch diameter rods or two 1 inch x 20 gauge straps.
3. Refer to "SMACNA DUCT CONSTRUCTION STANDARDS", 1985 ed., table 4-2 for additional information.

F. Support ducts with trapeze-type hangers with horizontal angle members and vertical support members of the sizes indicated for the corresponding duct sizes (long-side dimension):
   1. Up to 60 inch size; 1-1/2 inch x 1-1/2 inch x 1/8 inch angle and 1-1/2 inch x 16 gauge or 3/8 inch diameter hangers.
   2. Up to 84 inch size; 2 inch x 2 inch x 1/8 inch angle and 1-1/2 inch x 14 gauge or 1-1/2 inch diameter hangers.
   3. Over 84 inch size; 2 inch x 2 inch x 1/4 inch angle and 5/8 inch diameter hangers, except as otherwise shown.

3.3 SEISMIC RESTRAINTS:
   A. In areas where buildings are subject to seismic action, ducts shall be supported and braced per current SMACNA SEISMIC RESTRAINT MANUAL GUIDELINES FOR MECHANICAL SYSTEMS.

3.4 INSTALLATION OF FLEXIBLE DUCTS:
   A. Maximum Length: For any duct run using flexible ductwork, do not exceed 7 foot-0 inch extended length.
   B. Installation: Install in accordance with Section III of SMACNA's, "HVAC Duct Construction Standards, Metal and Flexible." Flexible duct shall not be used to form elbows. Flexible duct shall be used only for vertical drop to the diffuser.

3.5 CLEANING AND PROTECTION:
   A. Clean ductwork internally, unit-by-unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of the metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
   B. Strip protective paper from stainless ductwork surfaces, and repair finish wherever it has been damaged.
   C. Temporary Closure: At ends of ducts which are not connected to equipment of air distribution devices at the time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent the entrance of dust and debris until the time connections are to be completed.

END OF SECTION 15841