SECTION 15890

DUCTWORK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Metal Ductwork.

1.02 RELATED SECTIONS

A. Section 09900 - Painting: Weld priming, weather resistant, paint or coating.

B. Section 15140 - Supports and Anchors: Sleeves.

C. Section 15290 - Ductwork Insulation: External insulation and duct liner.

D. Section 15900 - Air Duct Cleaning

E. Section 15910 - Ductwork Accessories.

F. Section 15940 - Air Outlets and Inlets.

G. Section 15990 - Testing, Adjusting and Balancing.

1.03 REFERENCES

A. ASTM A 36 - Structural Steel.

B. ASTM A 90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

C. ASTM A 167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A 366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

E. ASTM A 480 - General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

F. ASTM A 525 - General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process.

G. ASTM A 527 - Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality.

H. ASTM A 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

I. ASTM A 569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

J. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

K. AWS D9.1 - Welding of Sheet Metal.

L. NBS PS 15 - Voluntary Product Standard for Custom Contact-Molded Reinforced-Polyester Chemical Resistant Process Equipment.

M. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

N. NFPA 90B - Installation of Warm Air Heating and Air Conditioning Systems.

O. SMACNA - HVAC Air Duct Leakage Test Manual.

P. SMACNA - HVAC Duct Construction Standards - Metal and Flexible (SMACNA HVACDCS).

Q. UL 181 - Factory-Made Air Ducts and Connectors.

1.04 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.05 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Provide data for duct materials, duct liner and duct connectors.

C. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 01700.

B. Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.07 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA HVACDCS.

1.08 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing the work of this section with minimum three years experience.

1.09 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A and NFPA 90B standards.

1.10 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealants.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Flexible Ducts:
   1. Flexible Technologies - Thermaflex product line.
   2. Atco Rubber Products, Inc.

B. Plastic Drawbands:
   1. Panduit.
   2. Thomas and Betts.
   3. Tyton.

C. Tape for Flexible Ducts:
   1. Ideal Tape Co., Inc.
   2. Fasson.
   3. Minnesota Mining and Manufacturing (3M).
   4. Nashua.
   5. Shurtape.
   6. Venture.

D. Sealants:
   1. Hardcast.
   2. Ductmate.
   3. Eco.
   4. Foster.
   5. United McGill.

E. Manufactured Ductwork - Round and Flat Oval:
   1. United McGill.
   2. Monroe Metal Mfg. Co.
   3. Semco.

F. Manufactured Ductwork - Transverse Duct Connection System:
   1. Ductmate.

2.02 MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90. Provide paint-grip exterior surfaces for exposed ducts.

B. Aluminum ducts: ASTM B209, aluminum sheet allow 3903-H14. Aluminum connectors and bar stock: Alloy 6061-T6 or equivalent strength.

C. Insulated Flexible Ducts:
   1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
   2. Pressure Rating: 10 inches WG (2.5 kPa) positive and 1.0 inches WG (250 Pa) negative.
   3. Maximum Velocity: 4000 fpm (20.3 m/sec).
   4. Temperature Range: -10°F to 160°F (-23°C to 71°C).

D. Drawbands for Flexible Ducts:
   1. Stainless Steel: 1/2-inch (13 mm) wide with screw-driven worm gear.
   2. Plastic: Panduit PLT5H or PLT8H; Thomas and Betts Dukt-Rap, VAL-26-50, or VAL-275X-25; or Tyton T150L or LX. Install with manufacturer's lever-action tightening tool.

E. Tape for Flexible Ducts: Ideal-Seal 587A/B, UL 181B-FX, aluminum foil with pressure-sensitive acrylic adhesive, -20°F to 250°F (-28°C to 121°C) temperature range.

F. Fasteners: Rivets, bolts, or sheet metal screws.

G. Sealants: See Duct Sealant portion of this Specification.

H. Hanger Rod: ASTM A36; galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.03 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVACDCS, as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

B. Construct Tees, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide single wall turning vanes. Do not use air foil turning vanes.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

F. Longitudinal locks or seams known as “button-punch-snap-lock” will not be permitted.

G. Exposed Ducts: Select and handle materials with care for a neat appearance. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufactured ductwork and fittings listed below are acceptable alternatives to standard ductwork systems.

B. Manufacture in accordance with SMACNA HVACDCS, and as specified or as indicated on the drawings. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

C. Transverse Duct Connection System: Interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips. Product shall be Ductmate or equal.

D. Exposed Ducts: Select and handle materials with care for a neat appearance. Joint connections on round and flat oval ducts shall be sleeve or flanged type; drawbands are not acceptable.

2.05 CASINGS

A. Fabricate casings in accordance with SMACNA HVACDCS and construct for operating pressures indicated.

B. Mount floor mounted casings on 4 inch (100 mm) high concrete curbs. At floor, rivet panels on 8 inch (200 mm) centers to angles. Where floors are acoustically insulated, provide liner of 18 gauge (1.20 mm) galvanized expanded metal mesh supported at 12 inch (300 mm) centers, turned up 12 inches (300 mm) at sides with sheet metal shields.

C. Reinforce door frames with steel angles tied to horizontal and vertical plenum supporting angles. Install hinged access doors where indicated or required for access to equipment for cleaning and inspection.

D. Fabricate acoustic casings with reinforcing turned inward. Provide 16 gauge (1.50 mm) back facing and 22 gauge (0.80 mm) perforated front facing with 3/32 inch (2.4 mm) diameter holes on 5/32 inch (4 mm) centers. Construct panels 3 inches (75 mm) thick packed with 4.5 lb/cu ft (72 kg/cu m) minimum glass fiber media, on inverted channels of 16 gauge (1.50 mm).

2.06 PRESSURE CLASSIFICATION

A. Ratings as indicated on the Drawings or as specified.

B. If no ratings are indicated, ductwork shall be rated for the external static pressure of the system plus twenty-five percent.

2.07 DUCT SEALING

A. Seal ductwork as outlined in the SMACNA HVACDCS. Seal ductwork to a minimum of class A in accordance with procedures as outlined in the manual.

B. Seal ductwork systems as required to ensure that maximum duct leakage does not exceed that allowed by the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual. Allow sealant to dry in accordance with manufacturer's requirements of time and environmental conditions before ductwork systems are pressurized.

C. Duct sealing materials used shall be non-flammable and non-combustible in both liquid and solid states.

D. Seal exposed ducts by applying mastic-type or gasket-type sealer just before the joint or seam is made; remove excess sealant for a neat appearance.

E. Materials for Sealing:
1. Hardcast gypsum-based tape and mastic, waterproof type when used on moist-air exhaust or in humid or outdoor locations.
2. Hardcast Flex Grip mastic.
3. Ductmate flanged lateral joints with gaskets.
4. Ductmate PROseal.
5. Eco 4450.
6. Or approved equal.

2.08 UNIFORMITY OF MATERIALS

A. Ductwork accessories, including but not limited to volume dampers, smoke dampers, fire dampers, combination fire/smoke dampers, backdraft dampers and motorized dampers, shall be fabricated of materials that are similar to the ductwork in which they are installed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install ducts in accordance with SMACNA HVACDCS.

C. Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

D. Exposed Ducts: Handle with care for a neat appearance. Repair or replace dented or damaged ductwork as required by the Architect. Select hangers for appearance, and to prevent sagging or distortion of duct.

E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pitot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

G. Use crimp joints with or without bead for joining round duct sizes 8 inch (200 mm) and smaller with crimp in direction of air flow.

H. Use double nuts and lock washers on threaded rod supports. Strap hangers shall be minimum 16-gauge (1.50 mm) x 1-inch (25 mm) galvanized straps. Hanger and support components including but not limited to "unistrut" shall be galvanized steel except where other duct materials are used. Wire hangers are not acceptable.

I. Connect diffuser boots to low pressure supply ducts directly or with 5 feet (1.5 m) maximum length of flexible duct held in place with strap or clamp. Minimum bend radius shall be one and one half times the duct diameter.

J. Connect flexible ducts to metal ducts with 2 turns of duct tape and metal draw bands. Plastic draw bands will not be accepted. Plastic drawbands may be used if they are installed using the band manufacturer's lever-action tightening tool. On insulated flexible ducts, provide an additional seal of tape and drawband on the insulation's vapor barrier.

K. Arrange door swings so that fan static pressure holds door in closed position.

L. During construction, provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Do not start ducted air moving equipment until construction is completed to a stage where airborne construction dust is no longer present. At the time of substantial completion, the entire air distribution system shall be turned over to the owner clear of construction dust and debris. If the interior surfaces of any ducted air moving equipment or the interior surfaces of any portion of the ductwork distribution system are found, as determined by the Architect, to contain significant construction dust and debris, the entire air distribution system shall be cleaned in accordance with specification Section 15910. If proper precautions are taken to prevent construction dust and debris from entering the ductwork during construction and if the Architect finds all ductwork to be free from such dust and debris, air duct cleaning shall not be required.

M. For fresh air intake and exhaust plenums connected to louvers or brick or block vents, pitch bottom of plenums down to bottom of louver at minimum 1/4" per foot (2 percent). Seal connections and joints on bottom of plenums watertight with mastic. Connect bottom of plenum to top-inside edge of bottom louver blade or waterstop as detailed on the drawings, to ensure positive drainage.

N. Install duct-mounted components furnished under other Sections of this Specification, such as smoke dampers, control dampers, control sensors, and smoke detectors. Install with straight lengths of duct as required for proper operation. Provide access at such components as required. Install in accessible locations for maintenance; notify the Architect if a location indicated or selected requires addition of access by other trades.

3.02 AIR DUCT LEAKAGE TESTS

A. Perform air duct leakage tests in accordance with the testing procedures outlined in the latest edition of the SMACNA HVAC Air Duct Leakage Test Manual. All tests shall be witness and signed off by agent of the owner.

B. The Following Duct Systems Shall Be Tested for Leakage, regardless of whether or not SMACNA recommends testing:
   1. Supply ductwork from fan outlets to inlets of VAV boxes.
   2. Return ductwork from fan inlets to point where ductwork serves less than 3 return registers and/or grilles.
   3. All supply and exhaust ductwork located on vertical mechanical chases.
   4. All supply ductwork serving duct furnace DF-1.

C. Once leakage tests are complete, submit leakage test report. Leakage test report forms shall include the following:
   1. Description of ductwork under test
   2. Duct design operating pressure
   3. Duct design test static pressure
   4. Duct capacity, air flow
   5. Maximum allowable leakage duct capacity times leak factor
   6. Test apparatus
      a. Blower
      b. Orifice, tube size
      c. Orifice size
      d. Calibrated
   7. Test static pressure
   8. Test orifice differential pressure
   9. Leakage

D. Air duct leakage testing shall be performed by an agency that is independent of the testing, adjusting and balancing (TAB) agency.

E. The TAB agent shall witness all duct leakage tests performed under specification Section 15890. At a minimum, the first duct leakage test shall be witnessed and approved by the TAB agent and the engineer. At a minimum, all subsequent duct leakage tests shall be witnessed and approved by the TAB agent. The TAB agent shall confirm proper testing procedures and shall give written approval of all leakage tests. If deficiencies are discovered, the TAB agent shall document these deficiencies to the contractor and the engineer. Once deficiencies are corrected, the TAB agent shall witness follow-up leakage tests.

F. Coordinate with TAB agency and receive written sign-off of all leakage tests by the TAB agent prior to submitting leakage test report.

3.03 SCHEDULES

A. DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	MATERIAL
All Indoor Ductwork	Galvanized Steel
All Outdoor Ductwork	Aluminum

B. DUCTWORK PRESSURE CLASS SCHEDULE

AIR SYSTEM	PRESSURE CLASS
RTU-1, 2 and 3 Supply ductwork upstream of VAV boxes	2 inch
Supply ductwork downstream of VAV boxes	1 inch
Toilet exhaust	1 inch
General exhaust	1 inch
1st floor parking level exhaust	2 inch
Duct furnace supply and return	1 inch

END OF SECTION