SECTION 233100

DUCTWORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Metal ductwork.

B. Casing and plenums.

C. Kitchen hood ductwork.

D. Duct cleaning.

1.2 RELATED SECTIONS

A. Division 03 - Cast-in-Place Concrete.

B. Division 09 - Painting: Weld priming, weather resistant, paint or coating.

C. Division 11 - Food Service Equipment.

D. Section 23 05 29 - Supports and Anchors: Sleeves.

E. Section 23 05 93 - Testing, Adjusting, and Balancing.

F. Section 23 07 13 - Duct Insulation: External insulation and duct liner.

G. Section 23 33 00 - Ductwork Accessories.

H. Section 23 36 00 - Air Terminal Units.

I. Section 23 37 00 - Air Outlets and Inlets.

1.3 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 568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

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

H. ASTM A 653 - Steel Sheet, Zinc-Coated (galvanized) or Zinc-Iron Alloy coated (galvanized) by the hot dipped process.

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

J. ASTM C 14 - Concrete Sewer, Storm Drain, and Culvert Pipe.

K. ASTM C 443 - Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

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

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

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

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

P. NFPA 96 - Installation of Equipment for the Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment.

Q. SMACNA - HVAC Air Duct Leakage Test Manual.

R. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

S. SMACNA - Fibrous Glass Duct Construction Standards.

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

1.4 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.

1.5 SUBMITTALS

A. Submit under the provisions of Division 01.

B. Shop Drawings: Indicate dimensions, sizes, material thickness, and location and sizes of field connections.

C. Product Data: Provide manufacturers literature and data sheets indicating rated capacities, dimensions, and accessories.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

A. Submit under the provisions of Division 01.

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

1.7 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

B. Maintain one copy of the document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with a minimum of five (5) years' documented experience.

B. Installer: Company specializing in performing the work of this section with a minimum of three (3) years' experience.

1.9 REGULATORY REQUIREMENTS

A. Construct ductwork to NFPA 90A, NFPA 90B and NFPA 96 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

2.1 MATERIALS

A. Galvanized Steel Ducts: All interior ducts shall be constructed of galvanized steel in accordance with ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating in conformance with ASTM A90.

B. All exterior ductwork and ductwork exposed to high humidities shall have G90 zinc coating.

C. Steel Ducts: ASTM A366, A569 and A568.

D. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

E. Flexible Ducts:
   1. Manufacturers:
      a) Flexmaster Type NI3E.
      b) OmniAir Series 1300.
   2. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire.
   3. Pressure Rating: 4 inches WG positive and 1.0 inches WG negative.
   4. Maximum Velocity: 4000 fpm.
   5. Temperature Range: -20 degrees F to 180 degrees F.

F. Insulated Flexible Ducts:
   1. Manufacturers:
      a) Flexmaster Type 5M.
      b) OmniAir Series 1200.
   2. UL 181, Class 1, aluminum laminate and polyester film with latex adhesive supported by helically wound spring steel wire; fiberglass insulation; aluminized vapor barrier film.
   3. Pressure Rating: 4 inches WG positive and 1.0 inches WG negative.
   4. Maximum Velocity: 4000 fpm.
   5. Temperature Range: -20 degrees F to 180 degrees F.

G. Stainless Steel Ducts: ASTM A167, Type 304.

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

I. Sealant:
   1. Manufacturers:
      a) Hardcast DT5300 Tape with FTA-20 adhesive.
      b) United MDT-300 with MTA-20 adhesive.
   2. Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used with tape.

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

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages and reinforcing for operating pressures indicated.

B. Construct Ts, 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 air foil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

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 gages heavier than duct gages indicated in SMACNA Standard. Joints shall be a minimum of 4-inch 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. Pittsburgh Lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable on rectangular ductwork.

G. Flanged duct systems shall be Ductmate or W.D.C.I. proprietary duct connection systems will be accepted. Duct constructed using these systems will refer to the manufacturers guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.

H. Formed - on flanges will be accepted. Formed on flanges will be constructed as SMACNA T-25 flanges, as defined in 1995 SMACNA Manual. No other construction pertaining to formed - on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42" wide or less and must include the use of corners, bolts, and cleat.

2.3 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufactured in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Round and Flat Oval Ducts:
   1. Manufacturers:
      a) United McGill Corporation.
      b) Semco Manufacturing Company.

c) Eastern Sheet Metal.

2. Machine made from round spiral lockseam duct with light reinforcing corrugations; fittings manufactured of at least two gages heavier metal than duct.

C. Double Wall Insulated Flat Oval Ducts:

1. Manufacturers:
   a) United McGill Corporation.
   b) Semco Manufacturing Company.
   c) Eastern Sheet Metal.
2. Machine made from round spiral lockseam duct with light reinforcing corrugations, galvanized steel outer wall, 1-inch-thick fiberglass insulation, perforated galvanized steel inner wall; fittings manufactured with solid inner wall.

D. Joints:

1. Joints 0"-20" diameter, interior slip coupling beaded at center, fastened to duct, with sealing compound applied continuously around joint before assembling and after fastening. Wrap joints with 3-inch-wide duct tape.
2. Joints 21"- 72" diameter, use 3 piece, gasketed, flanged joints consisting of two internal flanges (with integral mastic sealant) split to accommodate minor differences in duct diameter, and one external closure band designed to compress gasketing between internal flanges.
3. Joints 73" diameter and up, use companion angle flanged joints only as defined in SMACNA Manual. Refer to manual for proper sizing and construction details. Ductwall to be welded longitudinal seams.
4. Flat Oval Ducts shall be joined with the factory fitting as manufactured by Ductmate Industries. Consult the manufacturer for installation and construction guidelines. As an option, beaded sleeve joints may be used.

2.4 CASINGS

A. Fabricate casings in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and construct for operating pressures indicated.

B. Mount floor mounted casings on 4-inch-high concrete curbs. At the floor, rivet panels on 8-inch centers to angles. Where floors are acoustically insulated, provide liner of 18 gage galvanized expanded metal mesh supported at 12-inch centers, turned up 12 inches 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 gage back facing and 22 gage perforated front facing with 3/32-inch diameter holes on 5/32-inch centers. Construct panels 3 inches thick packed with 4.5 lb./cu ft minimum glass fiber media, on inverted channels of 16 gage.

2.5 KITCHEN HOOD EXHAUST DUCTWORK

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible and NFPA 96.

B. Construct of 16 gage carbon steel or 18 gage stainless steel, using continuous external welded joints.

2.6 MEDIUM- AND HIGH-PRESSURE DUCTWORK

A. Fabricate in accordance with SMACNA H.V.A.C. Duct Construction Standards - Metal and Flexible for pressure class indicated.

B. In general, medium- and high-pressure ductwork shall be fumed hood exhaust, dust collection and carbon monoxide exhaust systems, and supply ductwork downstream of air handling units serving terminal units. Refer to fan schedules for static pressures.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with the manufacturer's instructions.

B. Install in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible. Seal all ductwork with specified sealant.

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

D. 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.

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

F. Use crimp joints with or without bead for joining round duct sizes 8 inch and smaller with crimp in direction of air flow.

G. Use double nuts and lock washers on threaded rod supports.

H. Connect terminal units to supply ducts directly or with one-foot maximum length of flexible duct. Do not use flexible duct to change direction.

I. Connect diffusers to low pressure ducts with 5 feet maximum length of flexible duct held in place with strap or clamp.

J. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

K. Set plenum doors 6 to 12 inches above floor. Arrange door swings so that fan static pressure holds door in closed position.

L. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.

M. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

3.2 CLEANING

A. Clean work under the provisions of Division 01.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

C. Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. Provide adequate access to ductwork for cleaning purposes.

3.3 SCHEDULES

A. DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	MATERIAL
Low Pressure Supply	Steel
Buried Supply or Return	Steel, PVC Coated Steel, Concrete, Glass Fiber Reinforced Plastic
Medium- and High-Pressure Supply	Steel
Return and Relief	Steel
General Exhaust	Steel
Kitchen Hood Exhaust	Steel, Stainless Steel
Dishwasher Exhaust	Stainless Steel
Fume Hood Exhaust	Stainless Steel
Outside Air Intake	Steel
Combustion Air	Steel

B. DUCTWORK PRESSURE CLASS SCHEDULE

AIR SYSTEM	PRESSURE CLASS
Low Pressure Supply	1 inch
Medium- and High-Pressure Supply	2-1/2 inch
Return and Relief	1 inch
General Exhaust	1/2 inch
Dishwasher Exhaust	1/2 inch
Fume Hood Exhaust	2 inch
Outside Air Intake	1/2 inch
Combustion Air	1/2 inch

END OF SECTION