SECTION 23 31 00

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01 SPECIAL NOTE - This specification includes details for an ALTERNATE as defined in the Bid Form for this project. It is as follows:

A. BASE BID - Contractor shall provide KoolDuct fabricated ductwork systems for all CONCEALED DUCTWORK ONLY.

B. ALTERNATE BID - Contractor shall provide metal ductwork with external insulation as indicated in the specifications.

1.02 SECTION INCLUDES

A. Metal ductwork.

B. Nonmetal ductwork.

C. Casing and plenums.

D. Kitchen hood ductwork.

E. Duct cleaning.

1.03 RELATED REQUIREMENTS

A. Section 03 30 00 - Cast-in-Place Concrete.

B. Section 09 90 00 - Painting and Coating: Weld priming, weather resistant, paint or coating.

C. Section 11 40 00 - Foodservice Equipment: Supply of kitchen range hoods for placement by this Section.

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

E. Section 23 33 00 - Air Duct Accessories.

F. Section 23 36 00 - Air Terminal Units.

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

H. Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.04 REFERENCE STANDARDS

A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.

B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength, Low Alloy, and High-Strength Low-Alloy with Improved Formability, Solution Hardened, and Bake Hardenable.

E. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy, High-Strength Low-Alloy With Improved Formability, and Ultra-High Strength.

F. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.

G. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric].

H. ASTM C14 - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe.

I. ASTM C14M - Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe [Metric].

J. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.

K. ASTM C443M - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets (Metric).

L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; National Fire Protection Association.

M. NFPA 90B - Standard for the Installation of Warm Air Heating and Air Conditioning Systems; National Fire Protection Association.

N. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association.

O. SMACNA (LEAK) - HVAC Air Duct Leakage Test Manual; Sheet Metal and Air Conditioning Contractors' National Association.

P. SMACNA (DCS) - HVAC Duct Construction Standards.

Q. SMACNA (FGD) - Fibrous Glass Duct Construction Standards; Sheet Metal and Air Conditioning Contractors' National Association.

R. UL 181 - Standard for Factory-Made Air Ducts and Air Connectors; Underwriters Laboratories Inc..

1.05 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.

1.06 SUBMITTALS

A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.

B. Product Data: Provide data for duct materials and duct connections.

C. Shop Drawings: Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for all systems.

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

E. Manufacturer's Certificate: Certify that installation of glass fiber ductwork meet or exceed

recommended fabrication and installation requirements.

F. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

B. Installer Qualifications: Company specializing in performing the type of work specified in this section, with minimum five years of documented experience.

1.08 REGULATORY REQUIREMENTS

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

1.09 FIELD CONDITIONS

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

B. Maintain temperatures within acceptable range during and after installation of duct sealants.

PART 2 PRODUCTS

2.01 DUCT ASSEMBLIES

2.02 MATERIALS

A. **ALTERNATE CONCEALED DUCT MATERIAL**: Galvanized Steel for Ducts: Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G90/Z275 coating.

B. Aluminum for Ducts: ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061-T651 or of equivalent strength.

C. **BASE BID CONCEALED DUCT MATERIAL:** KoolDuct Fabricated Ductwork System:
   1. The panels used in the fabrication of ductwork from the Kingspan KoolDuct System shall be Kingspan KoolDuct rigid phenolic insulation panels of nominal dimensions 9.68 ft x 3.94 ft or 12.89 ft x 3.94 ft and minimum compressive strength 29 psi, as manufactured by Kingspan Insulation Ltd and detailed in App. A1.
   2. Kingspan KoolDuct rigid phenolic insulation panels shall comprise a 3.4-3.75 pcf nominal density CFC/HCFC-free rigid phenolic insulation core with zero Ozone Depletion Potential (ODP), autohesively bonded on both sides to a 1 mil low vapour permeability aluminium foil facing reinforced with a 0.2” glass scrim.
   3. Kingspan KoolDuct rigid phenolic insulation panels are available in thicknesses of 7/8”, 1 3/16” and 1 5/16”. For determination of the thickness required to achieve a specified thermal performance refer to App. A2.
   4. All other components required for the fabrication of ductwork from the Kingspan KoolDuct System including the silicone sealant, contact adhesive, aluminium tape, self-adhesive gasket, ductwork reinforcements, closures, connectors and flanges shall be as approved / supplied by Kingspan Insulation Ltd.
   5. Fire & Smoke Performance
   6. The rigid phenolic insulation panels used in the fabrication of ductwork and / or ductwork sections fabricated from the Kingspan KoolDuct System shall achieve the following fire and smoke performance requirements:
      a. ASTM E 84-08a - unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke

Developed indices;

b. UL 723 - unfaced or composite (insulation, facing and adhesive) of low contribution to fire growth not exceeding 25 Flame Spread and 50 Smoke Developed indices; and
c. UL 181 - UL/ULC classification as a Class 1 Air Duct to NFPA Standards 90A & 90B.
d. Fabrication of Ductwork

7. All ductwork fabricated from the Kingspan KoolDuct System shall be fabricated in accordance with methods as approved Kingspan Insulation Ltd.
8. Air Leakage
9. Ductwork system air leakage shall be in accordance with the requirements of the relevant jurisdiction. (Consult the DOE (US Department of Energy) ComCheck / ResCheck or the relevant authority for applicable codes / standards).
   a. Ductwork installations are required to be made sufficiently airtight to ensure quiet and economical operation of the system. The SMACNA HVAC Air Duct Leakage Test Manual, ANSI / ASHRAE / IESNA 90.1: 2007 and IECC 2003 & 2006 are referred to in many, but not all, specifications in order to determine the air leakage limits for ductwork systems.
   b. Ductwork sections fabricated from the Kingspan KoolDuct System shall not exceed permitted air leakage limits as follows:
   c. ANSI / ASHRAE / IESNA 90.1 and IECC 2003 & 2006 section 503.2.7
   d. The maximum allowable air leakage for all Class 6 (CL6) rectangular ducts is 6 x P0.65 as defined by
   e. SMACNA HVAC Air Duct Leakage Test Manual
10. All internal seams must be fully sealed with an unbroken layer of silicone sealant.
11. Each ductwork section must be duly connected with a jointing system approved Kingspan Insulation Ltd., and sufficient silicone sealant should be applied in order to seal the rigid phenolic insulation panel and ensure minimum air leakage.
12. Ductwork reinforcement, if necessary, shall be applied to protect against side deformation from both positive and negative pressure.
13. All external seams where two separate panels join must be taped to achieve a permanent bond and a smooth wrinkle free appearance.
14. The design of ductwork fittings shall be in conformance with the The ASHRAE Design Fundamentals Handbook Chapter 35 or SMACNA HVAC Duct System Design Manual.
15.

D. Insulated Flexible Ducts:
   1. Two ply vinyl film supported by helically wound spring steel wire; fiberglass insulation; polyethylene vapor barrier film.
      a. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
      b. Maximum Velocity: 4000 fpm.
      c. Temperature Range: -10 degrees F to 160 degrees F.

E. **BASE BID**:All concealed ducts: Galvanized steel, unless otherwise indicated.

F. **ALTERNATE PRICING** All Concealed Ducts: Galvanized steel, unless otherwise indicated.

G. Low Pressure Supply (Heating Systems): 1/2 inch w.g. pressure class, galvanized steel or KoolDuct in concealed spaces.

H. Low Pressure Supply (System with Cooling Coils): 1/2 inch w.g. pressure class, galvanized steel or KoolDuct in concealed spaces.

I. Return and Relief: 1/2 inch w.g. pressure class, galvanized steel or KoolDuct.

J. General Exhaust: 1/2 inch w.g. pressure class, galvanized steel or KoolDuct.

K. Kitchen Cooking Hood Exhaust: 1/2 inch w.g. pressure class, stainless steel.
   1. Asphalt base.
   2. Construct of 18 gage stainless steel using continuous external welded joints in rectangular sections.

L. Joint Sealers and Sealants: Non-hardening, water resistant, mildew and mold resistant.
   1. Type: Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
   2. VOC Content: Not more than 250 g/L, excluding water.

M. Grease Exhaust: 1/2 inch w.g. pressure class, stainless steel.
   1. Construct of ASTM A1011/A1011M 16 gage un-galvanized steel.
   2. Construction:
      a. Liquid tight with continuous external weld for all seams and joints.
      b. Where ducts are not self draining back to equipment, provide low point drain pocket with copper drain pipe to sanitary sewer.
   3. Access Doors:
      a. Provide for duct cleaning inside horizontal duct at drain pockets, every 20 feet and at each change of direction.
      b. Use same material and thickness as duct with gaskets and sealants rated 1500 degrees F for grease tight construction.
   4. Surface Burning Characteristics: Flame spread of zero, smoke developed of zero, when tested in accordance with ASTM E 84.

N. Outside Air Intake: 1/2 inch w.g. pressure class, galvanized steel or KoolDuct.

O. Hanger Rod: ASTM A 36/A 36M; steel; threaded both ends, threaded one end, or continuously threaded.

2.03 METAL DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards and as indicated.

B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

C. Construct T's, 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 must be used, provide turning vanes. .

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

E. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA HVAC Duct Construction Standards.

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

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

H. Where ducts are connected to exterior wall louvers and duct outlet is smaller than louver frame, provide blank-out panels sealing louver area around duct. Use same material as duct, painted black on exterior side; seal to louver frame and duct.

2.04 MANUFACTURED DUCTWORK AND FITTINGS

A. Manufacture 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. Double Wall Insulated Round Ducts: Round spiral lockseam duct with paintable galvanized steel outer wall, perforated galvanized steel inner wall; fitting with solid inner wall. Provide paint in color selected by architect.
   1. Manufacture in accordance with SMACNA HVAC Duct Construction Standards.
   2. Insulation:
      a. Thickness: 1 inch.
      b. Material: Fiberglass, with mylar coating between insulation and perforated liner.

C. Flexible Ducts: Two ply vinyl film supported by helically wound spring steel wire.
   1. Insulation: Fiberglass insulation with polyethylene vapor barrier film.
   2. Pressure Rating: 10 inches WG positive and 1.0 inches WG negative.
   3. Maximum Velocity: 4000 fpm.
   4. Temperature Range: -10 degrees F to 160 degrees F.

D. Transverse Duct Connection System: SMACNA "J" rated rigidly class connection, interlocking angle and duct edge connection system with sealant, gasket, cleats, and corner clips.
   1. Manufacturers:

2.05 CASINGS

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

B. Mount floor mounted casings on 4 inch high concrete curbs. At 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. Mount floor mounted casings on 4 inch high concrete curbs. At 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.

D. 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.
   1. Provide clear wire glass observation ports, minimum 6 X 6 inch size.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install, support, and seal ducts in accordance with SMACNA HVAC Duct Construction Standards.

B. Install in accordance with manufacturer's instructions.

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

D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.

E. Install and seal metal and flexible ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

F. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot 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.

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

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

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

J. Tape joints of PVC coated metal ductwork with PVC tape.

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

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

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

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

O. Use stainless steel for ductwork exposed to view and stainless steel or carbon steel for ducts where concealed.

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

Q. At exterior wall louvers, seal duct to louver frame and install blank-out panels as required.

R. KoolDuct installation - Additional Notes:
   1. Ductwork sections fabricated from the Kingspan KoolDuct System shall be installed in accordance with methods approved by Kingspan Insulation Ltd.
   2. The ductwork system shall be visually inspected before commencement of operation and ductwork sections fabricated from the Kingspan KoolDuct System shall be verified as having been installed correctly.
   3. Flexible connections shall be made between the ductwork and any item which is subject to vibration or movement.
   4. Support
      a. It shall be the responsibility of the installer to ensure that the ductwork system is properly and adequately supported. A number of support systems are approved for use by Kingspan Insulation Ltd. It shall be the responsibility of the installer to ensure that the chosen method of support is compatible with ductwork fabricated from the Kingspan KoolDuct System.
      b. With the exception of Tiger Supports, all metal support members in contact with the ductwork shall be separated by a soft gasket material.

c. Supports on straight runs of ductwork fabricated from the Kingspan KoolDuct System shall be positioned at centres not exceeding 10 ft for ductwork sections fabricated in 10 ft lengths, and 13 ft for ductwork sections fabricated in 13 ft lengths.
d. Additionally, ductwork shall be supported at changes of direction, at branch duct connections, tee fittings and etc.
e. All ductwork accessories such as dampers shall be independently supported.

5. Internal Ductwork
   a. All internal and exposed to view ductwork fabricated from Kingspan KoolDuct System may be provided with a protective finish in addition to the factory applied reinforced aluminium facing. The finish shall be either:
      1) aluminium / zinc alloy coated sheet steel (0.024”) which can be introduced during fabrication of the ductwork or installed in place; or
      2) a suitable paint finish (must not compromise factory applied reinforced aluminium facing or fire classification) applied in place.

3.02 RANGE HOOD EXHAUST DUCT INSTALLATIONS

A. Install ducts to allow for thermal expasion of ductwork through 2000 deg F temperature range.

B. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out.

C. Install ducts withouth dips or traps that may collect residues, unless traps have continuous or automatic residue removal.

D. Install access openings at each change in direction and at 50-foot intervals; locate on sides of duct a minimum of 1-1 1/2 inches from bottom; and fit with grease-tight covers of same material as duct.

E. Do not penetrate fire-rated assemblies.

3.03 CLEANING

A. 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 that could be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.04 SCHEDULES

A. Ductwork Material:
   1. Low Pressure Supply (Heating Systems): Steel, Aluminum, KoolDuct.
   2. Low Pressure Supply (System with Cooling Coils): Steel, Aluminum, KoolDuct
   3. Return and Relief: Steel, Aluminum, KoolDuct.
   4. General Exhaust: Steel, Aluminum, KoolDuct.
   5. Outside Air Intake: Steel, KoolDuct.
   6. Exposed round ductwork in all areas: Double-walled spiral.

B. Ductwork Pressure Class:
   1. Supply (Heating Systems): 1 inch
   2. Supply (System with Cooling Coils): 2 inch.
   3. Return and Relief: 1 inch.
   4. General Exhaust: 1 inch.
   5. Outside Air Intake: 1 inch.

END OF SECTION