SECTION 15810
DUCTWORK

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

A. The general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 General Requirements, apply to work specified in this Section.

B. Requirements of Section 15050, "Basic Mechanical Materials and Methods" apply to work specified in this Section.

1.02 SUMMARY

A. This Section specifies ducts, plenums and casings for heating, ventilating, and air conditioning systems in pressure classes from minus 2 inches to plus 10 inches water gage.

B. Work installed but not furnished under this section:
1. Installation of control dampers furnished by Section 15910 "Control Systems".
2. Installation of smoke detectors furnished by Division 16.

C. Related Work Specified in Other Sections:
1. Fire-resistant sealants for use around duct penetrations and fire damper installations in fire rated floors, partitions, and walls: Section 07840, "Firestopping".
2. Access panels and doors for access to concealed ducts: Section 08310, "Access Doors."
3. Louvers connected to duct systems and installed in exterior walls: Section 10200, "Louvers."
4. Flexible duct materials, dampers, duct-mounted access panels and doors, turning vanes, sound attenuatons and other accessories: Section 15820, "Duct Accessories".
5. Constant-volume boxes, and variable-volume boxes: Section 15840, "Variable Air Volume Boxes".
6. Diffusers, registers and grilles: Section 15850, "Diffusers, Registers, and Grilles".
7. Duct insulation: Section 15080, "Mechanical Insulation".
8. Automatic temperature control devices installed in ducts: Section 15910, "Control Systems".
9. Testing, adjusting, and balancing of ductwork: Section 15950, "Testing, Adjusting and Balancing".
10. Smoke Detectors: Division 16.

1.03 REFERENCED STANDARDS

A. NAIMA's "Fibrous Glass Duct Liner Standard"

B. Sheet Metal and Air Conditioning Contractor's Association (SMACNA)

1. Fibrous Glass Duct Construction Standards, 1992 Edition.

2. HVAC Duct Construction Standards, 1985 Edition

1.04 DEFINITIONS

A. Thermal Conductivity and Apparent Thermal Conductivity (k-Value): As defined in ASTM C 168. These values are the result of the formula Btu x in./h x sq. ft. x deg. F.

B. Seams: A seam is defined as joining of two longitudinally (in the direction of airflow) oriented edges of duct surface material occurring between two joints. All other duct surface connections made on the perimeter are deemed to be joints.

C. Joints: Joints include girth joints; branch and subbranch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum, and casing abutments to building structures.

1.05 SYSTEM DESCRIPTION

A. The duct system design, as indicated, has been used to select and size air moving and distribution equipment and other components of the air system. Changes to the layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

B. Design and obtain approval from authority with jurisdiction over seismic restraint hangers and support for ductwork.

1.06 SUBMITTALS

A. Product Data: Manufacturer's illustrated product literature, including details of construction, dimensions of individual components, profiles, and finishes for the following items:
1. Sound Attenuators
2. Ductwork, Shop Standards
3. Duct Liner.
4. Sealing Materials.

B. Fabrication, assembly, and installation details, including plans, elevations, sections, details of components, and attachments to other work. Include copy of SMACNA Tables and Figure numbers and configurations marked to identify which are to be used. After review, of fabrication details, submit duct fabrication drawings. (Duct fabrication drawings will not be reviewed prior to review of fabrication details.)

C. Duct fabrication drawings from duct fabrication shop, drawn to a scale not smaller than 1/4 inch equals 1 foot, on drawing sheets same size as the Contract Drawings, detailing:
1. Duct layout, indicating pressure classifications, gauges and sizes in plan view.
2. Fittings.
3. Reinforcement and spacing.
4. Seam and joint construction.
5. Penetrations through fire-rated and other partitions.

6. Terminal unit, coil, and humidifier installations.
7. Hangers and supports, including methods for building attachment, vibration isolation, seismic restraint, and duct attachment.

D. Licensed Engineers hanger and support drawings specified in the "Quality Assurance Article" below.

E. Perform tests specified in "Field Quality Control". Modify mock-up construction and perform additional tests as required to achieve specified minimum acceptable results.

F. Quality Assurance Submittals: Coordination drawings for ductwork installation in accordance with Section 01310, "Project Management and Coordination".

G. Closeout Submittals: Submit record drawings including duct systems routing, fitting details, reinforcing, support, installed accessories and devices in accordance and with Section 01700, "Closeout Procedures and Submittals".

1.07 QUALITY ASSURANCE

A. Licensed Engineer: Prepare hanger and support design drawings, and calculations for seismic restraint of ductwork. Include seal and signature of Registered Engineer, licensed in jurisdiction where project is located, certifying compliance with The Maine State Building Code.

B. NFPA Compliance: Comply with the following NFPA Standards:

1. NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems".

2. NFPA 90B, "Standard for the Installation of Warm Air Heating and Air Conditioning Systems".

C. NAIMA Compliance: Comply with the NAIMA's "Fibrous Glass Duct Liner Standard".

D. UL Compliance: UL listed and labeled as complying with UL 181, Class 1 for fibrous glass duct.

E. Acoustic performance certificates as specified for factory-fabricated casings.

1. Indicate sound absorption coefficients in each octave band when tested according to ASTM C 423.

2. Indicate airborne sound transmission losses when tested according to ASTM E 90.

D. Comply with USM IDAT per section 01810.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Deliver sealant materials to site in original unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle sealant materials in compliance with manufacturer's recommendations.

C. Deliver and store stainless steel sheets with mill-applied adhesive protective paper, maintained through fabrication and installation.

D. Deliver shop-fabricated and factory-fabricated casings, accessories and purchased accessories with protective crating and covering.

1.09 SEQUENCING AND SCHEDULING

A. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Roof specialties are specified in Division 7.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Subject to compliance with requirements, provide products of one of the following:

B. Transverse Duct Connectors:
1. Ductmate
2. TDC
3. United McGill

C. Duct Liner:
1. Knauf Fiber Glass
2. Owens Corning
3. Schuller International, Inc.

D. Duct Sealant
1. Hardcast.
2. United McGill.

2.02 DUCT MATERIALS

A. Sheet Metal, General: Provide sheet metal in thicknesses indicated, packaged and marked as specified in ASTM A 700.

B. Galvanized Sheet Steel: Lock-forming quality, ASTM A 527, Coating Designation G 90. Provide mill phosphatized finish for surfaces of ducts exposed to view.

C. Stainless Steel: ASTM A 480/A 480M, Type 316, sheet form, with No. 4 finish on surface of ducts exposed to view.

D. Aluminum Sheets: ASTM B 209, Alloy 3003, Temper H14, sheet form; with standard, one-side bright finish for ducts exposed to view, and mill finish for concealed ducts.

E. Reinforcement Shapes and Plates: Unless otherwise indicated, provide galvanized steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for all other ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for 36-inch length or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.03 DUCT AND CASING LINER

A. Materials: ASTM C 1071, Type II, with coated surface exposed to airstream to prevent erosion of glass fibers.
   1. Thickness: 1-1/2 inch.

   2. Density: 1-1/2 pounds.

   3. Thermal Performance: "K-Factor" equal to 0.28 or better, at a mean temperature of 75 deg F.

   4. Fire Hazard Classification: Flame spread rating of not more than 25 without evidence of continued progressive combustion and a smoke developed rating of no higher than 50, when tested in accordance with ASTM C 411.

   5. Liner Adhesive: Comply with NFPA Standard 90A and ASTM C 916.

   6. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct. Provide fasteners that do not damage the liner when applied as recommended by the manufacturer, that do not cause leakage in the duct, and will indefinitely sustain a 50-pound tensile dead load test perpendicular to the duct wall.
      a. Fastener Pin Length: As required for thickness of insulation, and without projecting more than 1/8 inch into the airstream.
      b. Adhesive For Attachment of Mechanical Fasteners: Comply with the "Fire Hazard Classification" of duct liner system.

   7. Fiberglass liner will be encased within a protective film (Mylar or Tedlar) to eliminate errosion and contamination of the air stream. Liner shall still conform to the above coating/sealing.

2.04 SEALING MATERIALS

A. Joint and Seam Sealant: All purpose industrial grade indoor/outdoor, water based sealant complying with ASTM C 731, ASTM C 732 and ASTM D 2202; formulated with a minimum of 63 percent solids.

   1. Sealant for exterior applications shall have a service temperature of -30 deg F to 175 deg F; ultraviolet ray– and ozone–resistant.

B. Flanged Joint Mastics: One-part, acid-curing, silicone elastomeric joint sealants, complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

2.05 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder actuated fasteners, or structural steel fasteners appropriate for building materials. Do not use powder actuated concrete fasteners for lightweight aggregate concretes or for slabs less than 4 inches thick.

B. Hangers: Galvanized, sheet steel, or round, threaded steel rod.

1. Hangers Installed In Corrosive Atmospheres: Electro galvanized, all-thread rod or hot-dipped-galvanized rods with threads painted after installation.

2. Straps and Rod Sizes: Comply with SMACNA "HVAC Duct Construction Standards - Metal and Flexible," 1995 Edition, for sheet steel width and gage and steel rod diameters.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes conforming to ASTM A 36/A 36M.

1. Supports for galvanized steel ducts: Hot-dipped-galvanized steel shapes and plates.

2. Supports for stainless steel ducts: Stainless steel support materials.

3. For aluminum ducts: Aluminum support materials, except where materials are electrolytically separated from ductwork.

2.06 PRESSURE CLASSIFICATIONS

A. Static Pressure Classifications: Except where otherwise indicated, construct duct systems to the following pressure classifications.

1. Classify as high pressure and construct the following work for minimum of 10 inch wg static pressure positive, Seal Class A, Leakage Class 6 for rectangular ductwork and Class 3 for round ductwork as recommended in SMACNA HVAC Duct Construction Standards, 1995 Edition, and HVAC Air Duct Leakage Test Standards:
   a. Supply air ductwork for variable air volume systems up to the first smoke damper.

2. Classify as medium pressure and construct the following work for minimum of 6 inch wg static pressure positive, Seal Class A, Leakage Class 6 for rectangular ductwork and Class 3 for round ductwork as recommended in SMACNA HVAC Duct Construction Standards, 1995 Edition, and HVAC Air Duct Leakage Test Standards.
   a. Supply ductwork for variable air volume systems up to the inlet side of variable air volume terminals.

3. Classify as industrial duct and construct the following work for minimum of 6 inch wg static pressure negative, Seal Class A, Leakage Class 6 for rectangular ductwork and

Class 3 for round ductwork as recommended in SMACNA Round Industrial Duct Construction Standards First Edition, and HVAC Air Duct Leakage Test Standards.

a. Exhaust ductwork for general lab, animal lab, fume hoods and distribution ductwork associated with fume exhaust unit (EF-1, EF-2 & EF-3).

4. Classify as low pressure and construct all ductwork and casings other than that listed above for minimum of 2 inch wg static pressure positive or negative as recommended in SMACNA HVAC Duct Construction Standards, 1985 Edition, except as follows:
   a. Seal seams, joints, fastener penetrations and connections in all ductwork Seal Class A, Leakage Class 6 for rectangular ductwork and Class 3 for round ductwork.
   b. Construct seams and joints in supply ductwork as recommended in SMACNA HVAC Duct Construction Standards, 1995 Edition, for minimum of 4 inches static pressure, positive.
   c. Button punch snaplocks and pocket locks are not permitted.

2.07 DUCT FABRICATION

A. General: Except as otherwise indicated, fabricate ducts, elbows, transitions, offsets, branch connections and other construction with galvanized sheet steel, in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible," 1995 Edition. Comply with the requirements for metal thickness, reinforcing types and intervals, tie rod applications, and joint types and intervals.

1. Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.

2. Provide materials that are free from visual imperfections such as pitting, seam marks, roller marks, stains, and discolorations.

B. Duct dimensions indicated on Drawings are inside clear dimensions.

C. Fabricate canopy hoods with 18-gage stainless steel. Weld and flange seams and joints.

D. Fabricate fume hood exhaust ductwork on floor plans that is associated with EF-19, EF-20 & EF-21 with 316 stainless steel with welded and flange seams and joints. All other exhaust ductwork shall be constructed of galvanized.

E. Crossbreaking or Cross Beading: Crossbreak or cross bead duct sides that are 19 inches and larger and are 20 gage or less, with more than 10 sq. ft. of unbraced panel area, as indicated in SMACNA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition, unless they are lined or externally insulated.

2.08 SHOP APPLICATION OF LINER IN RECTANGULAR DUCTS AND CASINGS

A. Adhere a single layer of indicated thickness of duct liner with 90 percent coverage of adhesive at liner contact surface area. Multiple layers of insulation to achieve indicated thickness are prohibited. Liner to be encase in a mylar or Tedlar film to eliminate errosion and contaimination of the air stream, additional acoustic spacer to be provided between the film and perforated inner liner.

B. Apply adhesive to liner facing in direction of airflow not receiving metal nosing.

C. Butt transverse joints without gaps and coat joint with adhesive.

D. Fold and compress liner in corners of rectangular ducts or cut and fit to assure butted edge overlapping.

E. Do not apply liners in rectangular ducts with longitudinal joints, except at corners of ducts, unless the size of the duct and standard liner product dimensions make longitudinal joints necessary.

F. Apply an adhesive coating on longitudinal seams in ducts exceeding 2,500 FPM air velocity.

I. Secure insulation liner, film and acoustic spacer with perforated sheet metal liner of same gage specified for duct, secured to ducts with mechanical fasteners that maintain metal liner distance from duct without compressing insulation. Sheet metal liner perforations: 3/32-inch-diameter, with an overall open area of 23 percent.

J. Terminate liner with duct buildouts installed in ducts to attach dampers, turning vane assemblies, and other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to the duct wall with bolts, screws, rivets, or welds. Terminate liner at fire dampers at connection to fire damper sleeve.

2.09 ROUND AND FLAT OVAL DUCT FABRICATION

A. General: "Diameter" as applied to flat-oval ducts in this Article 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.

B. Round Ducts: Fabricate round ducts with spiral lockseam construction, except where diameters exceed 72 inches. Fabricate ducts having diameters greater than 72 inches with longitudinal butt-welded seams. Comply with SMACNA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition, for galvanized steel gages.

B. Round Ducts: Fabricate round ducts using seam types identified in SMACNA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition, Figure 3-1, RL-1, RL-4, or RL-5. Seam Types RL-2 or RL-3 must be spot-welded on 1-inch intervals. Comply with SMACNA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition for galvanized steel gages.

C. Flat Oval Ducts: Fabricate flat oval ducts with standard spiral lockseams (without intermediate ribs) or with butt-welded longitudinal seams in gages listed in SMACNA "HVAC Duct Construction Standards-Metal and Flexible," 1995 Edition.

D. Double-Wall (Insulated) Ducts: Fabricate double-wall insulated ducts with an outer shell, insulation encased in film (Mylar or Tedlar), acoustic spacer, and an inner liner as specified below. Dimensions indicated on double wall ducts are inside dimensions.

1. Thermal Conductivity: 0.26 Btu/sq.ft./deg F/inch at 75 deg F mean temperature.

2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Fabricate outer shell lengths 2 inches longer than inner shell and insulation, and in gages specified above for single-wall duct.

3. Insulation: 1-1/2-inch-thick insulation liner, encased in film (maylar or tedlar). Provide insulation ends where internally insulated duct connects to single-wall duct or noninsulated components. Isulation end shall terminate insulation and reduce outer shell diameter to inner liner diameter.

4. Perforated Inner Liner: Fabricate round and flat oval inner liners with perforated sheet metal having 3/32-inch-diameter perforations, with an overall open area of 23 percent. Gauge and seam construction shall be as follows:
   a. 3 to 8 inch diameter: 24 gage with standard spiral seam construction.
   b. 9 to 42 inch diameter: 24 gage with single-rib spiral construction.
   c. 44 to 60 inch diameter: 22 gage with single-rib spiral construction.
   d. 62 to 88 inch diameter: 20 gage with standard spiral construction.

5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.10 ROUND AND FLAT OVAL SUPPLY AND EXHAUST FITTINGS FABRICATION

A. 90-Degree Tees and Laterals and Conical Tees: Fabricate to conform to SMACNA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition, and with metal thicknesses specified for longitudinal seam straight duct.

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

C. Elbows: Fabricate in die-formed, gored, pleated, or mitered construction. Fabricate bend radius of die-formed, gored, and pleated elbows 1.5 times elbow diameter. Unless elbow construction type is indicated, provide elbows meeting the following requirements:

1. Mitered Elbows: Fabricate mitered elbows with solid welded construction. Complying with SMACA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition for gauge and number of pieces.
   a. Flat Oval Mitered Elbows: Solid welded with same metal guage as longitudinal seam flat oval duct.

2. Round Elbows - 8 Inches and Smaller: Die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend angle configurations or 1/2-inch-diameter (e.g. 3-1/2- and 4-1/2-inch) elbows with gored construction.

3. Round Elbows - 9 Through 14 Inches: Gored or pleated elbows for 30, 45, 60, and 90 degrees, unless 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.

4. Round Elbows - Larger Than 14 Inches and All Flat Oval Elbows: Gored elbows, unless space restrictions require a mitered elbow.

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

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

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

8. Pleated Elbows Sizes Through 14 Inches and Pressures Through 10 Inches: 24 gage.

D. Double-Wall (Insulated) Fittings: Fabricate double-wall insulated fittings with an outer shell, insulation encased in film (Mylar or Tedlar), acoustic spacer, and an inner liner as specified below. Dimensions indicated on double wall ducts are inside dimensions.

1. Thermal Conductivity: 0.26 Btu/sq.ft./deg F/inch at 75 deg F mean temperature.

2. Outer Shell: Base outer shell gage on actual outer shell dimensions. Fabricate outer shell lengths 2 inches longer than inner shell and insulation. Gages for outer shell shall be same as for uninsulated fittings.

3. Insulation: Provide 1-1/2 inch-thick duct liner encased in film (Mylar or Tedlar). Provide insulation ends where internally insulated duct connects to single-wall duct or noninsulated components. Insulation end shall terminate insulation and reduce outer shell diameter to inner liner diameter.

4. Perforated Inner Liner: Fabricate round and flat oval inner liners with perforated sheet metal having 3/32-inch-diameter perforations, with an overall open area of 23 percent, and gages as listed below:
   a. 3 to 34 inches: 22 gage.
   b. 35 to 58 inches: 20 gage.
   c. 60 to 88 inches: 18 gage.

5. Maintain concentricity of liner to outer shell by mechanical means. Retain insulation from dislocation by mechanical means.

2.13 DUCT SILENCERS

A. General: Factory-fabricated and -tested, round or rectangular silencer with performance characteristics and physical requirements design for Laboratory, hospital spaces and as indicated.

B. Fire Performance: Adhesives, sealers, packing material, and accessory materials shall have fire ratings not exceeding 25 for flame spread and 50 for smoke developed when tested according to ASTM E 84, "Standard Test Method for Surface Burning Characteristics of Building Materials."

C. Rectangular Units: Fabricate casings with a minimum of 22-gage solid sheet metal for outer casing, liner encase in a mylar or Tedlar film, acoustic spacer and 26-gage perforated sheet metal for inner casing.

D. Round Units: Casings with sheet metal thicknesses for the casing diameters as listed below:
   1. Up to 24 inches: 22 gage.
   2. 26 through 40 inches: 20 gage.
   3. 42 through 52 inches: 18 gage.
   4. 54 through 60 inches: 16 gage.
   5. Casings fabricated of spiral lock seam duct may be 2 gages lighter than that indicated.
   6. Interior Partitions and Baffles: At least 22 gage, and designed for minimum aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch diameter for inner casing and baffle sheet metal.

F. Fibrous Acoustic Fill Material: Inert and vermin-proof fibrous material, packed under not less than 5 percent compression to eliminate voids due to vibration and settling. Encase acoustic fill material with mylar or Tedlar film.

G. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations.
   1. Do not use nuts, bolts, and sheet metal screws for unit assemblies.
   2. Lock form and seal or continuously weld joints.
   3. Suspended Units: Factory-installed suspension hooks or lugs attached to the frame in quantities and spaced to prevent deflection or distortion.
   4. Reinforcement: Cross angles or trapeze angles for rigid suspension.

H. Source Quality Control: Perform the following factory tests:
   1. Acoustic Performance: Test silencers with airflow in both directions through silencer, according to ASTM E 477, "Methods of Testing Duct Liner Materials and Prefabricated Silencers for Acoustical and Airflow Performance."
   2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels for both forward flow (air and noise in same direction) and reverse flow (air and noise in opposite directions) with an airflow of at least 2,000 FPM face velocity.
   3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch w.g. static pressure, whichever is greater.

PART 3 - EXECUTION

3.01 DUCT INSTALLATION, GENERAL

A. Install metal ducts and fittings in accordance with SMACNA "HVAC Duct Construction Standards - Metal and Flexible", 1995 Edition.

B. Duct System Pressure Class: Construct and install each duct system for the specific duct pressure classification indicated.

C. Install ducts with the fewest possible joints.

D. Install fabricated fittings for all changes in direction, changes in size and shape, and connections.

E. Install couplings tight to duct wall surface with a minim of projections into duct .

F. Install ducts, unless otherwise indicated, vertically and horizontally, parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a minimum clearance of 1-inch plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions, unless as specifically indicated.

J. Coordinate layout with suspended ceiling, fire-and smoke-control dampers, and lighting layouts and similar finished work.

K. Electrical Equipment Spaces: Route ductwork to avoid passing through transformer vaults and electrical equipment spaces and enclosures.

L. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of same gage as duct. Overlap opening on four sides by at least 1-1/2 inches.

M. Fire-Rated Partition Renetrations: Where ducts pass through fire-rated partitions and walls, install appropriately rated fire damper and sleeve.

3.02 DUCT LINER

A. Install lining of specified type and thickness in accordance with requirements and recommendations of the "SMACNA HVAC Duct Construction Standards", 1985 Edition.

B. Increase sheet metal ductwork in each dimension to incorporate thickness of lining material and provide an internal clear duct dimension as shown.

C. Duct liner encased in mylar film to eliminate delimitation of fibrous material into the air stream. Repair and maintain seal tight casing.

D. Line the following:
1. Refer to contract drawings.

3.03 SEAM AND JOINT SEALING

A. General: Seal duct seams and joints in accordance with pressure class indicated and as described in SMACA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition.:

B. Pressure Classification Less than 2 Inches Water Gage: Transverse joints only.

C. Seal externally insulated ducts prior to insulation installation.

3.04 HANGING AND SUPPORTING

A. Install rigid round, rectangular, and flat oval metal duct with support systems indicated in SMACNA "HVAC Duct Construction Standards-Metal and Flexible", 1995 Edition, Tables 4-1 through 4-3 and Figures 4-1 through 4-8, and SMACNA "Fibrous Glass Duct Construction Standards," 1992 Edition.

B. Support horizontal ducts within 2 feet of each elbow and within 4 feet of each branch intersection.

C. Support vertical ducts at a maximum interval of 16 feet and at each floor.

D. Upper attachments to structures shall have an allowable load not exceeding one-fourth the failure (proof test) load.

E. Install powder actuated concrete fasteners after concrete is placed and completely cured.

3.05 CONNECTIONS

A. Equipment Connections: Connect equipment with flexible connectors in accordance with Section 15820," Duct Accessories."

B. Branch, Diffuser, Register, Grille, and Terminal Unit Connections: Comply with SMACNA "HVAC Duct Construction Standards-Metal and Standard," 1995 Edition.

3.06 SMOKE DETECTORS

A. Install duct mounted smoke detectors furnished by Division 16.

3.07 FIELD QUALITY CONTROL

A. Test all supply, return and exhaust ductwork during installation and before application of any exterior insulation or enclosing of ductwork, in accordance with SMACNA "HVAC Air Duct Leakage Test Manual".
   1. Disassemble, reassemble, and seal segments of the systems as required to accommodate leakage testing, and as required for compliance with test requirements.
   2. Conduct tests, in presence of Arch/Owner, at static pressures equal to maximum design pressure of system or section being tested. If pressure classifications are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   3. Remake leaking joints and retest until leakage is less than maximum allowable leakage.

B. Comply with USM IDAT per section 01810.

3.08 ADJUSTING AND CLEANING

A. Refer to Section 15950, "Testing, Adjusting, and Balancing" for requirements and procedures for adjusting and balancing air systems.

B. After completing installation, including outlet fittings and devices, inspect the system. Vacuum ducts prior to final acceptance to remove dust and debris.

C. Clean dust and debris from each casing section as it is installed. Clean external surfaces of foreign substances that might deteriorate metal or interface with painting or insulating of casings.

D. Maintain temporarily closed openings in casings until permanently closed by duct connections, equipment installation, and completion of similar work. Cover openings with polyethylene film or other covering to prevent entrance of moisture, dust and debris.

END OF SECTION 15810