

SECTION 15290

DUCTWORK INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Ductwork insulation.
- B. Duct Liner.
- C. Insulation jackets.

1.02 RELATED SECTIONS

- A. Section 09900 - Painting: Painting insulation jackets.
- B. Section 15190 - Mechanical Identification.
- C. Section 15890 - Ductwork: Duct liner.

1.03 REFERENCES

- A. Section 01095 - References: Requirements for references and standards.
- B. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- C. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
- D. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- E. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- F. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
- G. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
- H. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
- I. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
- J. ASTM D1056 - Standard Specification for Flexible Cellular Materials - Sponge or Expanded Rubber.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- L. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
- M. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

- N. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- O. NAIMA National Insulation Standards.
- P. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.
- Q. SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- R. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.04 SUBMITTALS

- A. Section 01300: Procedures for submittals.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.
- B. Applicator Qualifications: Company specializing in performing the work of this section with minimum three years experience.

1.06 REGULATORY REQUIREMENTS

- A. Materials: Flame spread/smoke developed rating of 25/50 in accordance with ASTM E84, NFPA 255 and UL 723.
- B. Insulation materials shall be asbestos free. No fibers with dimensions similar to asbestos fibers shall be released from any material.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Section 01600 - Materials and Equipment: Transport, handle, store, and protect products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Section 01600 - Materials and Equipment: Environmental conditions affecting products on site.
- B. Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- C. Maintain temperature during and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Armstrong World Industries (product: elastomeric foam insulation).
- B. Ceel-Co (product: plastic jacket systems).
- C. Certainteed Manson.
- D. Childers (products: metal jacket systems, and mastics).
- E. Johns Manville.
- F. Knauf.
- G. Owens Corning.
- H. Rubatex Corporation (product: elastomeric foam insulation).

2.02 GLASS FIBER, FLEXIBLE

- A. Insulation: ASTM C553; flexible, noncombustible blanket.
 - 1. 'K' ('Ksi') value: ASTM C518, 0.27 at 75°F (0.039 at 24°C).
 - 2. Maximum service temperature: 250°F (121°C) faced and 350°F (176°C) unfaced.
 - 3. Maximum moisture absorption: 0.20 percent by volume.
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
 - 3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.
- D. Outdoor Vapor Barrier Mastic: Vinyl emulsion type acrylic or mastic, compatible with insulation, black color.
- E. Tie Wire: Annealed steel, 16 gage (1.5 mm).

2.03 GLASS FIBER, RIGID

- A. Insulation: ASTM C612; rigid, noncombustible blanket.
 - 1. 'K' ('Ksi') value: ASTM C518, 0.24 at 75°F (0.036 at 24°C).
 - 2. Maximum service temperature: 450°F (232°C).
 - 3. Maximum moisture absorption: 1.0 percent by volume.
 - 4. Density: 3.0 lb/cu ft (48 kg/cu m).
- B. Vapor Barrier Jacket:
 - 1. Kraft paper with glass fiber yarn and bonded to aluminized film.
 - 2. Moisture vapor transmission: ASTM E96; 0.02 perm.
 - 3. Secure with pressure sensitive tape.
- C. Vapor Barrier Tape: Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber based adhesive.

- D. Indoor Vapor Barrier Finish:
 - 1. Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight, glass fabric.
 - 2. Vinyl emulsion type acrylic, compatible with insulation, white color.

2.04 ELASTOMER FOAM DUCT LINER

- A. Approved Products:
 - 1. Armstrong World Industries, AP Armaflex sheet insulation.
 - 2. Rubatex Corporation: Insul-Sheet and Rubatex R-1800-FS sheet insulation.
- B. Insulation: ASTM C534; flexible, cellular elastomeric, molded or sheet.
 - 1. 'K' ('Ksi') value: ASTM C177; 0.277 Btu-in/(h-ft²-°F) at 75°F (0.04 W/m-K at 24°C).
 - 2. Minimum service temperature: -70°F (-57°C) (flexible to -40°F (-40 °C)).
 - 3. Maximum service temperature: 220°F (104 °C).
 - 4. Maximum moisture absorption: ASTM C209, 0.2% by volume; or ASTM D1056, 5% by weight.
 - 5. Moisture vapor transmission: ASTM E96; 0.20 perm-inches (1.16x10⁻¹⁰ Kg/(s-m-Pa)).
 - 6. Connection: Waterproof vapor barrier adhesive.
- C. Elastomeric Foam Adhesive: Air dried, contact adhesive, compatible with insulation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Section 01040 - Coordination: Verification of existing conditions before starting work.
- B. Verify that ductwork has been tested before applying insulation materials.
- C. Verify that surfaces are clean, foreign material removed, and dry.

3.02 INSTALLATION

- A. Section 01400 - Quality Control: Manufacturer's instructions.
- B. Install in accordance with NAIMA National Insulation Standards.
- C. Provide insulation for surfaces of new ductwork, as indicated and specified. Insulation values shall meet or exceed the requirements of ASHRAE 90.1-2001, State Energy Codes, and BOCA Energy Code requirements or Table I, whichever is greater.
- D. Insulated Ductwork Conveying Air below Ambient Temperature:
 - 1. Provide insulation with vapor barrier jackets.
 - 2. Finish with tape and vapor barrier jacket.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.
- E. Insulated Ductwork Conveying Air above Ambient Temperature:
 - 1. Provide with or without standard vapor barrier jacket.
 - 2. Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.
- F. Ductwork Exposed below 10 feet (3 meters) above finished floor in Mechanical Equipment Rooms or below 8 feet (2.4 meters) above finished floor in Finished Spaces: Provide glass fiber rigid insulation with vapor barrier jacket.

- G. Exterior Applications: Provide insulation with vapor barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.
- H. External Duct Insulation Application:
1. Secure insulation with vapor barrier with wires and seal jacket joints with vapor barrier adhesive or tape to match jacket.
 2. Secure insulation without vapor barrier with staples, tape, or wires.
 3. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers.
 4. Seal vapor barrier penetrations by mechanical fasteners with vapor barrier adhesive.
 5. Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.
- I. Duct and Plenum Liner Application:
1. Adhere insulation with adhesive for minimum 90 percent coverage.
 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA Standards for spacing.
 3. Seal and smooth joints. Seal and coat transverse joints.
 4. Seal liner surface penetrations with adhesive.
 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
 6. Acoustical Duct Lining: Edges of lining exposed to the airstream and not protected by Zee Strips shall be coated with adhesive. Liner shall be neatly butted without gaps at transverse joints and shall be coated with adhesive at such joints. Cover raw insulation such that no fibers are released.
 7. Provide and install duct liner where:
 - a. Indicated on the Drawings.
 - b. Specified.
 8. Install duct liner in accordance with SMACNA standards.
 9. Install elastomeric foam duct liner in accordance with manufacturer's recommendations.
 10. Liner shall be folded and compressed in the corners of rectangular duct sections or shall be cut and fit to assure butted edge overlapping. Longitudinal joints in duct liner shall not occur except at the corners of ducts unless the size of the duct and standard liner product dimensions make such necessary.
 11. Coat longitudinal joints in liner with adhesive.
 12. Metal nosings that are either channel or zee profile or are integrally-formed from the duct wall shall be securely installed over transversely oriented liner edges facing the airstream at fan discharge, at any interval of lined duct preceded by unlined duct and on upstream edges of liner at every transverse joint.
 13. Where dampers, turning vane assemblies or other devices are placed inside of lined duct or fittings, the installation shall not damage the liner or cause erosion of the liner. The use of metal hat sections or other buildout means is optional; when used, buildouts shall be secured to the duct wall with bolts, screws, rivets or welds.
 14. Liner shall also be installed with mechanical fastening devices meeting the following additional requirements:
 - a. Are spaced in accordance with SMACNA Guidelines.
 - b. When installed, are as corrosion-resistant as G60 coated galvanized steel.
 - c. Will not adversely affect the fire-resistant classification of liner and adhesives.
 - d. Do not damage the liner when applied as recommended by the manufacturer.
 - e. Do not cause leakage in the duct.
 - f. Do not project more than nominally into the airstream.
 - g. Will indefinitely sustain a 50 lb. (222 N) tensile dead load test perpendicular to the duct wall.
 - h. Are the correct length for the specified liner thickness.
 15. Do not install duct liner in fresh air intake ductwork between the outside intake opening and the fan or other air moving device, or within 10' (3 m) downstream of a cooling coil.

- J. Inspection Plates and Test Holes: Provide, where required, in ductwork or casings for balance measurements. Test holes shall be factory fabricated, airtight, and noncorrosive with screw cap and gasket. Extend cap through insulation.
- K. Install insulation after ductwork and equipment have been tested and approved.
- L. Ensure that surface is clean and dry prior to installation. Ensure that insulation is dry before and during application. Finish with system at operating conditions.
- M. Ensure that insulation is continuous through inside walls. Pack around ducts with fireproof self-supporting insulation material, properly sealed.
- N. Finish insulation neatly at hangers, supports and other protrusions.
- O. Locate insulation or cover seams in least visible locations.
- P. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship.
- Q. Do not insulate exposed ductwork in conditioned spaces or ductwork that is acoustically lined, unless otherwise specified or indicated on the Drawings.
- R. Standing seams, supporting angles and flanges on insulated ductwork shall be insulated with thickness equal to the duct and edges shall be finished and vapor sealed.
- S. Mechanical fasteners shall not be riveted or screwed to the duct and shall not penetrate the metalwork.
- T. For supply or return ductwork which is required to be insulated, insulation shall be continuous and shall include the insulating of register, grille and diffuser connection plenums/boots.

TABLE I
DUCTWORK INSULATION MATERIAL AND WALL THICKNESS

DUCTWORK TYPE	INSULATION MATERIAL	VAPOR BARRIER REQUIRED	INSULATION WALL THICKNESS
Exhaust ductwork from exterior building openings (such as louvers and roof hoods) to motorized damper or backdraft damper	Glass Fiber, Flexible (only if ductwork is concealed)	Yes	1 1/2" (38.1 mm)
	Glass Fiber, Rigid	Yes	1" (25.4 mm)
Supply Ductwork for heating and cooling systems with heating supply air temperatures greater than or equal to 100°F (All rooftop units)	Glass Fiber, Flexible	Yes	2" (50.8 mm)
	Glass Fiber, Rigid	Yes	2 layers of 1" (25.4 mm) with staggered joints
Exposed supply ductwork in mechanical or equipment rooms	Glass Fiber, Rigid	No for heating only systems, Yes for cooling systems	1" (25.4 mm)
Supply, return and exhaust ductwork in cold attic spaces, crawl spaces or any space outside of the building insulation envelope	Glass Fiber, Flexible	No for heating only systems, Yes for cooling systems	2" (50.8 mm)
	Glass Fiber, Rigid	No for heating only systems, Yes for cooling systems	2" (50.8 mm)

Transfer ducts	Elastomeric Foam Duct Liner	--	1" (25.4 mm)
Ductwork 10 feet upstream and downstream from a fan, or through the first elbow, whichever is longer.	Elastomeric Foam Duct Liner	--	1" (25.4 mm)
Ductwork shown on drawings to be acoustically lined	Elastomeric Foam Duct Liner	--	1" (25.4 mm)

Note: Supply ductwork located in second floor heated ceiling plenum is not required to be insulated.

END OF SECTION