

SECTION 23 07 00
HVAC INSULATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Heating, Refrigerating & Air-Conditioning Engineers Inc. (ASHRAE): 90.1, Energy Standard for Buildings Except Low-Rise Residential Buildings.
2. Association of the Nonwoven Fabric Industry (INDA). IST 80.6, Water Resistance (Hydrostatic Pressure).
3. ASTM International (ASTM):
 - a. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - b. C547, Standard Specification for Mineral Fiber Pipe Insulation.
 - c. C553, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - d. C1071, Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
 - e. C1139, Standard Specification for Fibrous Glass Thermal Insulation for Sound Absorbing Blanket and Board for Military Applications.
 - f. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
 - g. G21, Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
 - h. G22, Standard Practice for Determining Resistance of Plastics to Bacteria.
4. National Fire Protection Association (NFPA):
 - a. 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
 - b. 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
 - c. 259, Standard Test Method for Potential Heat of Building Materials.
5. UL.

1.02 DEFINITIONS

- A. Cold Air Ductwork: Designed to convey mechanically cooled air or return ducts in such systems.
- B. Warm Air Ductwork: Designed to convey mechanically heated air or return ducts in such systems.

1.03 SUBMITTALS

- A. Action Submittals: Product description, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.
- B. Informational Submittals:
 - 1. Proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.
 - 2. Operation and maintenance data as specified in Section 01 78 23, Operation and Maintenance Data.

1.04 QUALITY ASSURANCE

- A. Materials furnished under this specification shall be standard, cataloged products, new and commercially available, suitable for service requiring high performance and reliability with low maintenance, and free from all defects.
- B. Provide materials by firms engaged in the manufacture of insulation products of the types and characteristics specified herein, whose products have been in use for not less than 5 years.
- C. UL listing or acceptable certified test report from an approved testing laboratory is required to indicate fire hazard ratings for materials proposed for use do not exceed those specified.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Manufacturer's Stamp or Label:
 - 1. Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to Project Site for use must have manufacturer's stamp or label attached, giving name of manufacturer, brand, and description of material.
 - 2. Insulation Packages and Containers: Marked "asbestos-free."

PART 2 PRODUCTS

2.01 GENERAL

A. Physical Characteristics:

1. Insulation Exterior: Cleanable, grease-resistant, non-flaking, and non-peeling.
2. Insulation: Conform to referenced publications and specified temperature ranges and densities in pounds per cubic foot.
3. Insulation for Fittings, Flanges, and Valves: Pre-molded, precut, or job-fabricated insulation of same thickness and conductivity as used on adjacent piping.
4. Fire Resistance:
 - a. Insulation, Adhesives, Vapor Barrier Materials and Other Accessories, Except as Specified Herein: Noncombustible.
 - b. Do not use fugitive or corrosive treatments to impart flame resistance.
 - c. Flame proofing treatments subject to deterioration resulting from the effects of moisture or high humidity are not acceptable.
 - d. Provide materials including facings, mastics, and adhesives, with fire hazard rating not to exceed 25 for flame spread without evidence of continued progressive combustion, and 50 for smoke, developed as per tests conducted in accordance with ASTM E84 (NFPA 255) methods.
5. Materials exempt from fire-resistant rating:
 - a. Polyamide anchors.
 - b. Treated wood inserts.
6. Materials exempt from fire-resistant rating when installed in outside locations, buried, or encased in concrete:
 - a. Polyurethane insulation.
 - b. PVC casing.
 - c. Fiberglass-reinforced plastic casing.

B. Functional Characteristics; None.

C. Performance Characteristics: None.

2.02 PIPE INSULATION

A. Type P1 – Fiberglass (ASTM C547, Type 1):

1. Physical Characteristics:
 - a. Fiberglass, UL-rated, performed, sectional rigid, with factory – applied all-service jacket (ASJ).

- b. All-service Jacket:
 - 1) Composed of reinforced kraft paper and aluminum foil laminate.
 - 2) Provide self-sealing lap to facilitate closing longitudinal and end joints.
 - 2. Functional Characteristics: Minimum 4 pounds per cubic foot (pcf) density, K factor 0.23 maximum at 75 degrees F mean.
 - 3. Performance Characteristics: None.
- B. Type P3—Elastomeric (ASTM C534, Minus 40 Degrees F to 220 Degrees F):
 - 1. Manufacturers and Products:
 - a. Armacell; AP Armaflex.
 - b. Or equal.
 - 2. Physical Characteristics: Flexible, closed cell elastomeric.
 - 3. Functional Characteristics:
 - a. Nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
 - b. Water vapor transmission 0.1 perm-inch, or less.
 - 4. Performance Characteristics: None.

2.03 DUCT INSULATION

- A. Type D1—Blanket (ASTM C553, Type 1, Class B3):
 - 1. Manufacturers and Products:
 - a. CertainTeed; Duct Wrap.
 - b. Or equal.
 - 2. Physical Characteristics: Fiberglass, UL-rated, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures to 250 degrees F.
 - 3. Functional Characteristics: Nominal 1 pcf density blanket, K factor 0.31 maximum at 75 degrees F mean.
 - 4. Performance Characteristics: None.
- B. Type D2—Board:
 - 1. Manufacturers and Products:
 - a. CertainTeed; CertaPro Commercial Board.
 - b. Or equal.
 - 2. Physical Characteristics: Fiberglass.
 - 3. Functional Characteristics: Minimum 2.75 pcf density board, K factor 0.23 maximum at 75 degrees F mean, with factory-applied FSK (foil-scrim-kraft) vapor barrier jacket, for temperatures from 0 degree F to 450 degrees F.
 - 4. Performance Characteristics: None.

C. Type D3—Liner (ASTM C1071, Type 1):

1. Manufacturers and Products:
 - a. CertainTeed; Toughgard.
 - b. Or equal.
2. Physical Characteristics:
 - a. Fiberglass, nominal 1.5 pcf density liner, K factor 0.25 maximum at 75 degrees F mean, black composite coated surface exposed to airstream to prevent erosion of glass fibers, for temperatures to 250 degrees F.
 - b. Resistant to microbial growth using a “no growth criteria” when tested in accordance with ASTM C1139, ASTM G21, and ASTM G22.
3. Functional Characteristics:
 - a. Liquid water repellency rating not less than 4 when tested in accordance with INDA IST 80.6.
 - b. Potential heat value not exceeding 3,500 Btu/lb when tested in accordance with NFPA 259 and meeting the classification of “Limited Combustible” as defined by NFPA 90A.
 - c. Maximum rated velocity not less than 6,000 fpm when tested in accordance with ASTM C1071.
4. Performance Characteristics: None.

D. Type D5—Flexible Elastomeric (ASTM 534, Type I for tubular materials and Type II for sheet materials):

1. Manufacturers and Products:
 - a. Aeroflex USA Inc.; Aerocel.
 - b. Or equal.
2. Physical Characteristics: Closed-cell, sponge- or expanded-rubber materials.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

2.04 EQUIPMENT INSULATION

A. Type E1—Elastomeric (ASTM C534):

1. Manufacturers and Products:
 - a. Armstrong; Armaflex II.
 - b. Or equal.
2. Physical Characteristics: Flexible, closed-cell elastomeric, nominal 6 pcf density, K factor 0.27 maximum at 75 degrees F mean.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

2.05 INSULATION FINISH SYSTEMS

A. Type F1—PVC:

1. Manufacturers and Products:
 - a. Johns Manville; Zeston.
 - b. Or equal.
2. Physical Characteristics: Polyvinyl chloride (PVC) jacketing, white, for straight run piping and fitting locations, temperatures to 150 degrees F.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

B. Type F2—Paint:

1. Manufacturers and Products:
 - a. Armstrong; WB Armaflex finish.
 - b. Or equal.
2. Physical Characteristics: Acrylic latex paint, white, and suitable for outdoor use.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

C. Type F3—Aluminum:

1. Manufacturers and Products:
 - a. RPR Products; INSUL-MATE.
 - b. Or equal.
2. Physical Characteristics:
 - a. Aluminum Roll Jacketing: For straight run piping, wrought aluminum Alloy 3003, 5005, 1100 or 3105 to ASTM B209 with H-14 temper, minimum 0.016-inch thickness, with smooth mill finish.
 - b. Moisture Barrier: Provide factory applied moisture barrier, consisting of 40-pound kraft paper with 1-mil-thick low-density polyethylene film, heat and pressure bonded to inner surface of the aluminum jacketing.
 - c. Fitting Covers: Material as for aluminum roll jacketing, pre-molded, one- or two-piece covers, which includes elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

D. Type F5—Stainless Steel:

1. Manufacturers and Products:
 - a. RPR Products; Insul-Mate.
 - b. Or equal.
2. Physical Characteristics:
 - a. Stainless Steel Roll Jacketing: Manufactured from Type 304 or Type 316 prime grade annealed Austenitic stainless steel with a regular 2B mill finish for flatness and reduced glare. The yield strength is 30,000 psi, the tensile is 75,000 psi. Meet ASTM A240 and ASTM A666 standards, minimum 0.010-inch thickness, with smooth mill finish.
 - b. Vapor Barrier: Provide factory applied vapor barrier, 40 kraft (1-1/2-mil polyethylene) or a 3-mil polysurlyn moisture retarder which is heat and pressure bonded to the interior surface. Provide moisture retarder to prevent galvanic corrosion caused by contact of dissimilar metals in the presence of moisture or chemical corrosion which may result from installing sheets over damp insulation materials.
 - c. Fitting Covers: Match jacketing material, pre-molded and manufactured to meet ASTM C450, one-piece or two-piece covers, including elbows, tee/valves, end caps, mechanical line couplings, and specialty fittings.
3. Functional Characteristics: None.
4. Performance Characteristics: None.

PART 3 EXECUTION

3.01 APPLICATION OF PIPING INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices.
- B. Apply insulation over clean, finish painted, and dry surfaces.
- C. Install insulation after piping system has been pressure tested and leaks corrected.
- D. Use insulating cements, lagging adhesives, and weatherproof mastics recommended by insulation manufacturer.
- E. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete the run. Do not use cut pieces of scraps abutting each other.
- F. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.

- G. Maintain integrity of vapor-barrier jackets on pipe insulation and protect to prevent puncture or other damage. Seal open ends of insulation with mastic. Sectionally seal all butt ends of chilled water and condensate drain piping insulation at fittings with white vapor barrier coating.
- H. Cover valves, flanges, fittings, and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job-fabricated units. Finish cold pipe fittings with white vapor barrier coating and hot piping with white vinyl acrylic mastic, both reinforced with glass cloth.
- I. Extend piping insulation without interruption through walls, floors, and similar piping penetrations, except where otherwise indicated.
- J. Install protective metal shields and foam glass inserts where pipe hangers bear on outside of insulation.
- K. Insulation on piping that is to be heat traced shall be installed after installation of heat tape.
- L. Insulate valve bodies, flanges, and pipe couplings.
- M. Insulate and vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.
- N. Do not insulate flexible pipe couplings and expansion joints.
- O. Do not allow insulation to cover nameplates or code inspection stamps.
- P. Install removable insulation sections on devices that require access for maintenance of equipment or removal, such as unions and strainer end plates.
- Q. Cold Surfaces: Provide continuous vapor seal on insulation on cold surfaces where vapor barrier jackets are used.
- R. Placement:
 - 1. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.
 - 2. Insulate valves and fittings with sleeved or cut pieces of same material.
 - 3. Seal and tape joints.
- S. Insulation at Hangers and Supports: Install under piping, centered at each hanger or support.

T. Vapor Barrier:

1. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.
2. Install vapor barrier jackets with pipe hangers and supports outside jacket.
3. Do not use staples and screws to secure vapor sealed system components.

3.02 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with the manufacturer's written instructions and in accordance with recognized industry practices.
- B. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulation. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation and protect it to prevent puncture and other damage. Tape all punctures.
- E. Seal longitudinal and circumferential joints with FSK tape, and finish with fiberglass mesh fabric embedded in vapor barrier mastic.
- F. Extend ductwork insulation without interruption through walls, floors, and similar ductwork penetrations, except where otherwise indicated.
- G. Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- H. Refer to Section 23 31 13, Metal Ducts and Accessories, for installation of internal duct liner.

3.03 INSTALLATION OF EQUIPMENT INSULATION

- A. Application Requirements: Insulate where external surface temperature of equipment is below ambient temperature in the space, including surfaces that have a recognized possibility for condensation.
- B. Install equipment thermal insulation products in accordance with manufacturer's written instructions and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- C. Install insulation materials with smooth and even surfaces and on clear and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.

- D. Maintain integrity of vapor-barrier on equipment insulation and protect it to prevent puncture and other damage.
- E. Provide removable insulation sections to cover parts of equipment that must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames, and accessories.
- F. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture-saturated units.
- G. Avoid using scrap pieces of insulation where larger sheets will fit.

3.04 INSTALLATION OF INSULATION FINISH SYSTEMS

- A. Use a continuous friction type joint to hold jacket in-place, providing positive weatherproof seal over entire length of jacket.
- B. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
- C. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
- D. Do not use screws or rivets to fasten the fitting covers.
- E. Install removable prefabricated aluminum covers on exterior flanges and unions.
- F. Caulk and seal all exterior joints to make watertight.

3.05 PIPING INSULATION REQUIREMENTS

- A. Refrigeration Suction:
 - 1. Type P3, elastomeric.
 - 2. 1/2-inch thickness for pipe sizes up to 1 inch.
 - 3. 3/4-inch thickness for pipe sizes over 1 inch.
- B. Refrigeration Hot Gas Reheat:
 - 1. Type P3, elastomeric.
 - 2. 3/4-inch thickness.
- C. Condensate Drain:
 - 1. Type P3, elastomeric.
 - 2. 1/2-inch thickness for pipe sizes up to 2-5/8 inches ID.
 - 3. 3/4-inch thickness for pipe sizes over 2-5/8 inches ID.

D. Pipe Hangers:

1. Type P1, Fiberglass: UL-rated, preformed rigid pipe insulation inserts of thickness equal to adjoining insulation, 10 inches in length, with factory-applied, vinyl-coated and embossed vapor barrier jacket with self-sealing lap.
2. Type P3, Elastomeric: Rigid insulation section with 9-inch-long, 16-gauge galvanized steel saddle.

3.06 DUCTWORK INSULATION REQUIREMENTS

A. Mechanically Cooled and Heated Supply and Return Air; (Concealed):

1. Type D1, blanket.
2. 2-inch thickness.

B. Mechanically Cooled and Heated Supply and Return Air, and Outside Air (Exposed to View):

1. Type D2 or Type D5, board.
2. 1-1/2-inch thickness.

C. Mechanically Cooled and Heated Supply and Return Air; (Within 30 Feet of Air Handling Unit):

1. Type D3, liner.
2. 1-1/2-inch thickness.

D. Mechanically Cooled and Heated Supply and Return Air, and Outside Air (run in attic with ceiling insulation): Increase specified insulation thickness by 1/2 inch.

E. Mechanically Cooled and Heated Supply Air, Return Air, and Outside Air (outdoors):

1. Type D3, liner.
2. 2-inch thickness.

F. Outside Air Intake:

1. Type D1, blanket.
2. 1-1/2-inch thickness.

G. Mechanically Cooled and Heated Supply Air (within 10 feet of fan-powered terminal unit discharge):

1. Type D3, liner.
2. 1-1/2-inch thickness.

- H. Unheated Supply Air:
 - 1. Type D3, liner.
 - 2. 1-inch thickness.
- I. Air Distribution Devices: Refer to Section 23 37 00, Air Outlets and Inlets, for requirements.

3.07 INSULATION FINISH REQUIREMENTS

- A. Piping, Duct, and Equipment Insulation (Concealed Areas): Factory finish.
- B. Piping Insulation (Exposed to View, Indoors): Type F1, PVC.
- C. Ductwork Insulation (Exposed to View, Indoors): Factory finish.
- D. Equipment Insulation (Exposed to View, Indoors): Type F2, paint (for use with Type P3, elastomeric).
- E. Piping Insulation (Outdoors):
 - 1. Type F2, paint (for use with Type P3, elastomeric).
 - 2. Type F3, aluminum.
- F. Apply coating of insulating cement where needed to obtain smooth and continuous appearance.

3.08 FIELD QUALITY CONTROL

- A. Test factory-applied materials assembled. Field-applied materials may be tested individually.

END OF SECTION