

## SECTION 15083 - MECHANICAL INSULATION

## PART 1 - GENERAL

## 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

## 1.2 SUMMARY

- A. This Section includes insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.
- B. Related Sections include the following:
  - 1. Division 7 for firestopping materials and requirements for penetrations through fire and smoke barriers.
  - 2. Division 15 Section "Hangers and Supports" for pipe insulation shields and protection saddles.

## 1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Shop Drawings: Show fabrication and installation details for the following:
  - 1. Application of protective shields, saddles, and inserts at pipe hangers for each type of insulation and hanger.
  - 2. Attachment and covering of heat trace inside insulation.
  - 3. Insulation application at pipe expansion joints for each type of insulation.
  - 4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
  - 5. Removable insulation at piping specialties and equipment connections.
  - 6. Application of field-applied jackets.
- C. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets with requirements indicated. Include dates of tests.

## 1.4 QUALITY ASSURANCE

- A. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
- B. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

### 1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Ship insulation materials in containers marked by manufacturer with appropriate ASTM specification designation, type and grade, and maximum use temperature.
- B. Insulation must be stored and protected from moisture.
- C. Follow manufacturer's recommended handling practices.

### 1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."
- B. Coordinate clearance requirements with other trades for insulation application.
- C. Coordinate installation and testing of steam or electric heat tracing.

### 1.7 SCHEDULING

- A. Schedule insulation application after testing systems. Insulation application may begin on segments of systems that have satisfactory test results.

## PART 2 - PRODUCTS

### 2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
  - 1. Mineral-Fiber Insulation:
    - a. CertainTeed Manson.
    - b. Knauf FiberGlass GmbH.
    - c. Owens-Corning Fiberglas Corp.
    - d. Schuller International, Inc.
  - 2. Flexible Elastomeric Thermal Insulation:
    - a. Armstrong World Industries, Inc.
    - b. Rubatex Corp.

### 2.2 PIPING INSULATION MATERIALS

- A. Mineral Fiber Glass: Knauf Pipe Insulation; heavy density molded one piece; maximum temperature 1000°F.
  - 1. Thermal Conductivity (k value) of .21 at 75°F mean temperature.
  - 2. Conforming to ASTM C 547; ASTM C 585; NFPA 90A and 90B; noncombustible.
  - 3. ASJ/SSL Jacketing conforming to ASTM C 1136, Type I (replacing HH-B-100B); with a maximum vapor transmission rating of .02 perms.
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
  - 1. Adhesive: As recommended by insulation material manufacturer.
  - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

- C. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in pre-forming insulation to cover valves, elbows, tees, and flanges.

### 2.3 FIELD-APPLIED JACKETS FOR PIPING

- A. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
  - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, etc.
  - 2. Adhesive: As recommended by insulation material manufacturer.

### 2.4 DUCTWORK INSULATION MATERIALS

- A. Flexible Fiber Glass Blanket: Knauf Fiber Glass Duct Wrap; conforming to ASTM C 553, Type I, II or III
  - 1. Thermal Conductivity (k value) of at least .29 at 75°F mean temperature.
  - 2. Vapor Barrier Jacket: Foil-Scrim-Kraft (FSK); conforming to ASTM C 1136, Type II (replacing HH-B-100B); and having a maximum vapor transmission rating of .02 perms. Secured in place using outward clinch staples and appropriate pressure sensitive foil tape or glass fabric and vapor barrier mastic.
  - 3. Installation: Maximum allowable compression is 25%.
  - 4. Density:
    - a. Concealed Areas: .75 PCF (pounds per cubic foot).
    - b. Exposed Areas: 1.0 PCF (pounds per cubic foot).
- B. Fire Protection Wrap: John Mansville Firetemp Wrap, or approved equal; high temperature insulation blanket specifically designed to a two-hour fire rating around commercial and industrial applications, such as kitchen exhaust grease ducts, HVAC ducts, chemical exhaust ducts, and refuse and linen chutes.
  - 1. Wrap shall be a flexible, fire protection wrap that meets the requirements defined by the Underwriters Laboratories (UL) and the National Fire Protection Association (NFPA 96). Wrap shall be a UL classified soluble amorphous wool blanket, completely encapsulated in a UL classified, aluminum foil, fiberglass-reinforced scrim.
  - 2. Wrap shall be fully tested against internal grease ducts fires (UL1978), external fires (ASTM E 119/UL263), through penetration insulated duct fires (ASTM 814/UL1479), wall fires (ASTM E 119), and surface burning (ASTM E 84/UL723). Omega Point Laboratory and Underwriters Laboratory (UL), third party, fire endurance testing agencies accredited by ICBO, BOCA, and SBBCI (National Evaluation Services) in the United States, performed these tests and are providing reference listings.
  - 3. Wrap for grease duct applications shall use two layers of 1-1/2" wrap. The interior layer is applied with a butt joint. The second layer is offset a minimum of six inches from the initial layer. It is applied with an overlap of three inches and the insulated duct is banded with stainless steel straps.
- C. Through penetrations shall be firestopped using either JM Firetemp™ CI or SI firestopping products. All penetrations shall be packed with Firetemp Wrap blanket and the hole sealed with 1/2" thickness of either firestopping product.

### 2.5 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Comply with MIL-C-20079H, Type I for cloth and Type II for tape. Woven glass-fiber fabrics, plain weave, presized a minimum of 8 oz./sq. yd..
  - 1. Tape Width: 4 inches.

- B. Bands: 3/4 inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0.007 inch thick.
  - 4. Brass: 0.010 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.

## 2.6 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

## 2.7 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

## 2.8 PREPARATION

- A. Surface Preparation: Clean and dry surfaces. Remove materials that will adversely affect insulation application.

## 2.9 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs and equipment.
- E. Apply multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- H. Keep insulation materials dry during application and finishing.
- I. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.

- J. Apply insulation with the least number of joints practical.
- K. Air duct coverings shall not be installed so as to conceal or prevent use of any service opening.
- L. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic.
  - 1. Apply insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 12 inches from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
  - 3. Install insert materials and apply insulation to tightly join the insert. Seal insulation-to-insulation inserts with adhesive or sealing compound recommended by the insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect the jacket from tear or puncture by the hanger, support, and shield.
- M. Insulation Terminations: For insulation application where vapor retarders are indicated, taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- N. Apply adhesives and mastics at the manufacturer's recommended coverage rate.
- O. Maintain manufacturer's recommended temperatures and conditions for tapes, adhesives, mastics and cements.
- P. Apply insulation with integral jackets as follows:
  - 1. Pull jacket tight and smooth.
  - 2. Circumferential Joints: Cover with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip and spaced 4 inches o.c.
  - 3. Longitudinal Seams: Overlap jacket seams at least 1-1/2 inches. Apply insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
  - 4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
  - 5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic.
- Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
  - 1. Firestopping and fire-resistive joint sealers are specified in Division 7.
  - 2. Patching, Filling, and Repairing. Where air ducts pass through walls, floors, or partitions required to have a fire resistance rating and where fire dampers are not required, the opening in the construction around the air duct shall not exceed 25 mm (one inch) average clearance on all sides and shall be filled solid with an approved material capable of preventing the passage of flame and hot gases sufficient to ignite cotton waste when

subjected to the same NFPA 251 time-temperature fire condition required for fire barrier penetration.

- S. Floor Penetrations: Apply insulation continuously through floor assembly.
  - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

## 2.10 DUCTWORK INSULATION INSTALLATION

- A. Blanket Applications for Ducts and Plenums: Secure blanket insulation with adhesive and anchor pins and speed washers.
  - 1. Apply adhesives according to manufacturer's recommended coverage rates per square foot, for 100 percent coverage of duct and plenum surfaces.
  - 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
  - 3. Install anchor pins and speed washers on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    - a. On duct sides with dimensions 18 inches and smaller, along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    - b. On duct sides with dimensions larger than 18 inches. Space 16 inches o.c. each way, and 3 inches maximum from insulation joints. Apply additional pins and clips to hold insulation tightly against surface at cross bracing.
    - c. Anchor pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    - d. Do not over-compress insulation during installation.
  - 4. Impale insulation over anchors and attach speed washers.
  - 5. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
  - 6. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from one edge and one end of insulation segment. Secure laps to adjacent insulation segment with 1/2-inch staples, 1-inch o.c., and cover with pressure-sensitive tape having same facing as insulation.
  - 7. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. Secure with steel band at end joints and spaced a maximum of 18 inches o.c.
  - 8. Apply insulation on rectangular duct elbows and transitions with a full insulation segment for each surface. Apply insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  - 9. Insulate duct stiffeners, hangers, and flanges that protrude beyond the insulation surface with 6-inch-wide strips of the same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with anchor pins spaced 6 inches o.c.
  - 10. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

## 2.11 PIPING MINERAL-FIBER INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
  - 1. Secure each layer of preformed pipe insulation to pipe with wire, tape, or bands without deforming insulation materials.
  - 2. Where vapor retarders are indicated, seal longitudinal seams and end joints with vapor-retarder mastic. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation segments.

3. For insulation with factory-applied jackets, secure laps with outward clinched staples at 6 inches o.c.
  4. For insulation with factory-applied jackets with vapor retarders, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by the insulation material manufacturer and seal with vapor-retarder mastic.
- B. Apply insulation to flanges as follows:
1. Apply preformed pipe insulation to outer diameter of pipe flange.
  2. Make width of insulation segment the same as overall width of the flange and bolts, plus twice the thickness of the pipe insulation.
  3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
  4. Apply canvas jacket material with manufacturer's recommended adhesive, overlapping seams at least 1 inch, and seal joints with vapor-retarder mastic.
- C. Apply insulation to fittings and elbows as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded insulation elbows and fittings are not available, apply mitered sections of pipe insulation, or glass-fiber blanket insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
  3. Cover fittings with standard PVC fitting covers.
  4. Cover fittings with heavy PVC fitting covers. Overlap PVC covers on pipe insulation jackets at least 1 inch at each end. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
- D. Apply insulation to valves and specialties as follows:
1. Apply premolded insulation sections of the same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
  2. When premolded insulation sections are not available, apply glass-fiber blanket insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, arrange insulation for access to stainer basket without disturbing insulation.
  3. Apply insulation to flanges as specified for flange insulation application.
  4. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
  5. Use preformed heavy PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and vapor-retarder mastic.
  6. For larger sizes where PVC fitting covers are not available, seal insulation with canvas jacket and sealing compound recommended by the insulation material manufacturer.

## 2.12 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation and fabricate fittings in accordance with the manufacturer's installation instructions.
- B. Pipe and tubing insulation:
1. Use proper size material. Do not stretch or strain insulation.
  2. To avoid undue compression of insulation, provide cork stoppers or wood inserts at supports as recommended by the insulation manufacturer.

3. Where possible, slip insulation over the pipe or tubing prior to connection, and seal the butt joints with adhesive. Where the slip-on technique is not possible, slit the insulation and apply it to the pipe sealing the seam and joints with contact adhesive. Optional tape sealing, as recommended by the manufacturer, may be employed. Make changes from mineral fiber insulation in a straight run of pipe, not at a fitting. Seal joint with tape.

#### 2.13 FIELD-APPLIED JACKET APPLICATION

- A. Apply PVC jacket where indicated, with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

#### 2.14 FINISHES

- A. Glass-Cloth Jacketed Insulation: Paint insulation finished with glass-cloth jacket as specified in Division 9 Section "Painting."
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

#### 2.15 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Provide protective insulation as required to prevent personnel injury: Piping from zero to seven feet above all floors and access platforms including continuous blowoff, feedwater and boiler water sample, blowoff tank vent, flash tank vents and condensate tank vents, shot-type chemical feed, fire-tube boiler bottom blowoff after valves, valve by-passes, and any other related hot surface
- C. All cold surfaces that may "sweat" must be insulated. Vapor barrier must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapor seal. All hangers, supports, anchors, or other projections that are secured to cold surfaces shall be insulated and vapor sealed to prevent condensation.
- D. Freeze protection of above grade outdoor piping (over heat tracing tape): one inch thick insulation, with metal jacket, for all pipe sizes 3 inches and smaller, and 1-1/2 inch thick insulation for larger pipe. Provide for cold water make-up to cooling towers and for condenser water piping and chilled water piping.
- E. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  1. Flexible connectors.
  2. Vibration-control devices.
  3. Fire-suppression piping.
  4. Drainage piping located in crawl spaces, unless otherwise indicated.
  5. Below-grade piping, unless otherwise indicated.
  6. Chrome-plated pipes and fittings, unless potential for personnel injury.
  7. In hot piping: Unions, flexible connectors, control valves, PRV's, safety valves and discharge vent piping, vacuum breakers, thermostatic vent valves, steam traps 20 mm (3/4 inch) and smaller, exposed piping through floor for convectors and radiators. Insulate piping to within approximately 2 inches of un-insulated items.



## 2.16 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.
- B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

## 2.17 PIPING INSULATION APPLICATION SCHEDULE

- A. Service: Domestic hot and recirculated hot water.
  - 1. Operating Temperature: 60 to 140 deg F.
  - 2. Insulation Material: Mineral fiber.
  - 3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Pipe 1-1/4" and less: 1".
  - 4. Field-Applied Jacket: None.
  - 5. Vapor Retarder Required: No.
  - 6. Finish: None.
- B. Service: Domestic cold water.
  - 1. Operating Temperature: 35 to 60 deg F.
  - 2. Insulation Material: Mineral fiber.
  - 3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. All pipe sizes: 1".
  - 4. Field-Applied Jacket: None.
  - 5. Vapor Retarder Required: Yes.
  - 6. Finish: None.
- C. Service: Heating hot-water supply and return.
  - 1. Operating Temperature: 100 to 200 deg F.
  - 2. Insulation Material: Mineral fiber.
  - 3. Insulation Thickness: Apply the following insulation thicknesses:
    - a. Runouts up to 12 feet in length: 0.5".
    - b. All other pipe sizes: 1-1/2"
  - 4. Field-Applied Jacket: None.
  - 5. Vapor Retarder Required: No.
  - 6. Finish: None.

## 2.18 DUCT SYSTEM APPLICATION SCHEDULES

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Materials and thicknesses for systems listed below are specified in schedules at the end of this Section.
- C. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
  - 1. Factory-insulated flexible ducts.
  - 2. Factory-insulated plenums, casings, terminal boxes, and filter boxes and sections.
  - 3. Flexible connectors.
  - 4. Vibration-control devices.
  - 5. Testing agency labels and stamps.

6. Nameplates and data plates.
  7. Access panels and doors in air-distribution systems.
- D. Indoor Duct And Plenum Application Schedule
1. Service: **ALL** ductwork within the attic space.
    - a. Material: Mineral-fiber blanket.
    - b. Thickness: 1 inch.
    - c. Number of Layers: One.
    - d. Field-Applied Jacket: None.
    - e. Vapor Retarder Required: Yes.
  2. Service: Commercial kitchen-hood exhaust duct associated with EF-3.
    - a. Material: Fire protection wrap.
    - b. Thickness: 1-1/2 inches.
    - c. Number of Layers: Two.
    - d. Field-Applied Jacket: None.
    - e. Vapor Retarder Required: No.

END OF SECTION 15083