

SECTION 23 07 16
HVAC EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 STIPULATIONS

- A. The specifications sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

- A. This Section includes blanket, board, and block insulation; custom removable insulating jackets; insulating cements; accessories and attachments; and sealing compounds.

1.3 ACTION SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

- A. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed a craft training program offered by the Contractor, insulation material manufacturer, or trade association relating to the installation of equipment insulation for commercial, industrial and institutional applications. Installers shall also have no less than one (1) year of relevant experience.
- B. Installation Standards: The application of insulation shall conform to the Midwest Insulation Contractors Association's (MICA) "National Commercial and Industrial Insulation Standards", 8th Edition, except where the content of this Section conflicts.
- C. 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.
 - 1. Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Materials used outside the building are exempt from the above requirement.
- D. Minimum Insulation Thicknesses and R-Values: Conform to requirements of ASHRAE Standard 90.1-2016 and the 2018 International Energy Conservation Code (IECC), or the requirements of this Section, whichever is most demanding.

1.6 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. Protect materials from dirt and water. If insulation materials are dirtied or wetted, they shall not be installed, or shall be removed from the equipment if wetted or soiled after installation.

1.7 COORDINATION AND SCHEDULING

- A. Coordinate clearance requirements for insulation application during the preparation of shop drawings and coordination drawings, and during equipment installation.
- B. Schedule the application of insulation on cold / below-ambient piping systems, and associated equipment, to occur during the winter months, or with the cooling system de-energized. Substrates shall be completely dry at the time of application. Do not restore cooling service until the insulation installation is complete.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Glass Mineral-Fiber Insulation:
 - a. CertainTeed Corp.
 - b. Johns Manville Corp.
 - c. Knauf Insulation
 - d. Manson Insulation Inc.
 - e. Owens-Corning Fiberglas Corp.
 - f. Or equal as approved by the Professional.
 - 2. Custom Fitted Removable Thermal Insulation Blankets (Above Ambient Services):
 - a. Advance Thermal Corporation
 - b. Coverflex Manufacturing Inc.
 - c. Firwin Corp.
 - d. Insultech LLC
 - e. Ohio Valley Industrial Services (Hot Caps)
 - f. ThermaXX Jackets LLC
 - g. Pacor Inc.
 - h. Removable Insulation Covers; a Div. of Arric Corp.
 - i. Or equal as approved by the Professional.

2.2 INSULATION MATERIALS

- A. General Requirements: All insulation materials shall comply with the following:
 - 1. Products shall not contain asbestos, lead, mercury, or mercury compounds.

2. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
 3. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
 4. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- B. Glass Mineral-Fiber Board Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB, 3 PCF density, both with and without facing. Facing shall be an all-service jacket (ASJ) manufactured from kraft paper, fiberglass reinforcing scrim, and aluminum foil backing, complying with ASTM C 1136, Type I.
1. Board without facing shall only be used with a field-applied jacket.
 2. Water vapor permeance for facing shall be 0.02 perms, maximum, as per ASTM E96- Procedure A.
- C. Glass Mineral-Fiber Blanket Thermal Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 1393, Type IIIB, Category 2, 2-1/2 PCF density, both with and without facing. Facing shall be an all-service jacket (ASJ) manufactured from kraft paper, fiberglass reinforcing scrim, and aluminum foil backing, complying with ASTM C 1136, Type I.
1. Blanket without facing shall only be used with a field-applied jacket.
 2. Water vapor permeance shall be 0.02 perms, maximum, as per ASTM E96- Procedure A.

2.3 JACKET TAPES

- A. All-Service Jacket (ASJ) Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
1. Width: 3 inches.
 2. Thickness: 11.5 mils.
 3. Adhesion: 90 ounces force/inch in width.
 4. Elongation: 2 percent.
 5. Tensile Strength: 40 lbf/inch in width.
 6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

2.4 CUSTOM FITTED REMOVABLE THERMAL INSULATION BLANKETS (ABOVE AMBIENT SERVICES)

- A. Needled and felted blanket insulation mats with blanket jacketing material shall be on both sides of the blanket. The blankets shall be custom fit to the item being insulated and shall be designed to be easily removed for periodic inspections or maintenance, and then easily re-installed without the use of tools. Insulation must be sewn as integral part of the jacket to prevent shifting of the insulation.
1. The blankets shall use 1" slide buckles and/or "hook and loop" (e.g. Velcro®) fasteners to overlap seams for a tight seal.
 2. Double sewn lock stitch with a minimum 4 stitches per inch. Jackets shall be sewn with two (2) parallel rows of stitching. The thread must be able to withstand the skin temperatures without degradation.
 3. No raw cut jacket edges shall be exposed.
 4. Provide a permanently attached aluminum or stainless steel nameplate on each jacket to identify its location, size and tag number.

5. The insulation shall be designed to minimize the convection current in the space between the hot metal surface and the inner layer of insulation. To this end, during jacket fabrication, the layers of insulating mat shall be placed in an overlapping pattern. Insulation must be sewn as integral part of the jacket to prevent shifting of the insulation.
 6. Jackets may be constructed in a box shape where space permits and where required for removal and replacement inspection ease.
- B. Jacket material shall be PTFE-coated fiberglass fabric with a minimum 500°F temperature rating and minimum weight of 16.5 oz./sq. yd. Jacket shall be noncombustible. The material shall be suitable for interior or exterior use.
 - C. Insulation material shall be minimum 6 lb./cu ft. density fiberglass with a temperature rating of 1,000 deg. F. Maximum K factor of the thermal insulation shall be .35 at 300°F. Refer to application schedules and articles herein for minimum required thickness.
 - D. Do not insulate the portion of equipment, valves, etc. that the manufacturer has specifically recommended against insulating.

2.5 ACCESSORIES AND ATTACHMENTS

- A. Bands: 3/4-inch-wide, in one of the following materials compatible with jacket:
 1. Stainless Steel: ASTM A 167 or ASTM A 240, Type 304; 0.015 inch thick.
 2. Aluminum: ASTM B 209 (ASTM B 209M), Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick.
- B. Wire: 0.080-inch, nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel; or 0.062-inch, soft-annealed, galvanized steel.
- C. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 1. Welded Pin Holding Capacity: 100 lb for direct pull perpendicular to the attached surface.
- D. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 100 lb for direct pull perpendicular to the adhered surface.
- E. Self-Adhesive Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated.
- F. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

2.6 VAPOR RETARDERS

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

2.7 CORNER ANGLES

- A. Aluminum Corner Angles: 0.040-inch-thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
 - 1. Verify that systems and equipment to be insulated have been tested and are free of defects.
 - 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; and free of voids throughout the length of equipment.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each equipment 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 the wet or dry state.
- D. Apply multiple layers of insulation with longitudinal and end seams staggered.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Keep insulation materials dry during application and finishing.
- G. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by the insulation material manufacturer.
- H. Apply insulation with the least number of joints practical.
- I. Apply insulation over fittings and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated.

- J. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic. Apply insulation continuously through hangers and around anchor attachments.
- K. Insulation Terminations: For insulation application where vapor retarders are indicated, seal ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - a. For below ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints.
- M. Cut insulation according to manufacturer's written instructions to prevent compressing insulation to less than 75 percent of its nominal thickness.
- N. Install vapor-retarder mastic on equipment scheduled to receive vapor retarders. Overlap insulation facing at seams and seal with vapor-retarder mastic and pressure-sensitive tape having same facing as insulation. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-retarder seal.
- O. Insulate equipment scheduled to receive insulation in this Section or as indicated on the Drawings.
- P. Omit insulation from the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Manholes.
 - 5. Hand holes.
 - 6. Cleanouts.
 - 7. Equipment provided with factory insulation and jacketing meeting the requirements of the relevant Division 23 Section.
 - 8. Do not insulate the portion of equipment, valves, etc. for which the manufacturer has specifically recommended against insulating.

3.4 INDOOR EQUIPMENT, TANK AND VESSEL INSULATION APPLICATION

- A. Fiberglass Blankets, Board, and Block Applications for Tanks and Vessels: Secure 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 tank and vessel surfaces.

2. Groove and score insulation materials to fit as closely as possible to the equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joint. Stagger end joints.
3. Protect exposed corners with secured corner angles.
4. Install adhesive-attached or self-adhesive anchor pins and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. On tank and vessel, 3 inches' maximum from insulation end joints, and 16 inches o.c. in both directions.
 - c. Do not over-compress insulation during installation.
 - d. Cut and miter insulation segments to fit curved sides and dome heads of tanks and vessels.
5. Impale insulation over anchor pins and attach speed washers.
6. 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
7. Secure each layer of insulation with stainless-steel bands.
8. Stagger joints between insulation layers at least 3 inches.
9. Apply insulation in removable segments on equipment access doors and other elements that require frequent removal for service.
10. Bevel and seal insulation ends around manholes, hand holes, ASME stamps, and nameplates.
11. Apply vapor-retarder mastic to open joints, breaks, and punctures for insulation indicated to receive vapor retarder.

3.5 PUMP INSULATION SCHEDULE

- A. Insulate steam condensate pumps with custom fitted removable thermal insulation blankets, with insulation no less than 2" thick. Insulate all sides of receiver tanks and pump bodies. Connecting piping shall be insulated as specified for steam condensate piping in Division 23 Section "HVAC Piping Insulation".

3.6 PIPELINE APPURTENANCE INSULATION SCHEDULE

- A. Steam System: Steam Traps and Automatic Temperature Control Valves.
 1. Insulation Material: Custom Fitted Removable Thermal Insulation Blankets.
 2. Insulation Thickness: 3-inches.
 3. Note: Insulate thermostatic and disc type steam traps according to the trap manufacturer's requirements to ensure proper operation.
- B. Heating Hot Water System: Triple Duty Valves / Flow Control Valves / Balancing Valves / Balancing Cocks on pumps.
 1. Insulation Material: Custom Fitted Removable Thermal Insulation Blankets.
 2. Insulation Thickness: 1-1/2-inches.
- C. Steam and Heating Hot Water Systems: Shut off valves (e.g. ball, gate, butterfly, etc.), strainers, check valves, and similar pipeline appurtenances not specified above to have Custom Fitted Removable Thermal Insulation Blankets shall be insulated and jacketed as per the connecting piping as per Division 23 Section 230719.

1. Exception: Control valves and unions sized 1" and smaller in concealed locations or in mechanical spaces shall be left uninsulated on heating hot water systems.
- D. Provide labels on piping jacketing at check valves, unions, and other obscured appurtenances so their locations can be identified afterwards.

3.7 INTERIOR TANK, EQUIPMENT, AND VESSEL INSULATION SCHEDULE

- A. Heating hot-water air separators and expansion tanks.
1. Insulation Material: Glass mineral fiber board with ASJ, back-scored to conform to equipment profiles.
 2. Insulation Thickness: 2-inches.
 3. Field-Applied Jacket: None.
 4. Vapor Retarder Required: No.
- B. Heating hot-water combination feeder-filter vessels.
1. Insulation Material: Custom Fitted Removable Thermal Insulation Blankets.
 2. Insulation Thickness: 2-inches.
- C. Shell and Tube, Steam-to-Water Heat Exchangers, heating service.
1. Insulation Material: Custom fitted removable thermal insulation blanket on head, glass mineral fiber board, back-scored to conform to equipment profiles on shell.
 2. Insulation Thickness: 3-inches.
 3. Field-Applied Jacket: None
 4. Vapor Retarder Required: No.

END OF SECTION