

SECTION 23 07 00 – INSULATION

PART 1 - GENERAL

1.1 SYSTEM DESIGN REQUIREMENTS

- A. Provide minimum insulation thickness as suggested in ASHRAE Standard 90A.
- B. Provide removable insulation for chilled water pumps and specialty valves and fittings.

1.2 DEFINITIONS

- A. Concealed: As used in this Section refers to insulation in ceiling plenums, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, unexcavated areas, and crawl spaces.
- B. Exposed: As used in this Section refers to insulation that is not concealed.

1.3 QUALITY ASSURANCE

- A. Composite insulation, including jackets, coverings, sealers, mastics, and wet or dry adhesives shall have a flame spread rating of 25 or less and smoke-developed rating of 50 or less, as tested by ASTM E84.
- B. Elastomeric foam with a smoke-developed rating of 150 or less may be used, except in ducts, plenums, and concealed spaces that are part of the air distribution system
- C. PVC fitting covers shall have a maximum flame spread of 25 or less and are exempted from the smoke spread criteria.
- D. Duct liner shall comply with NAIMA Fibrous Glass Duct Liner Standard.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Insulation: Identification and/or type of material from a manufacturer is as shown under each heading of 2.2 Materials, General.
 - a. Manville Products
 - b. CertainTeed.
 - c. Rubatex
 - d. Knauf
 - e. Pittsburgh Corning
 - 2. Adhesives, Coatings, and Sealants:
 - a. Foster
 - b. Childers Product Company
 - c. Hardcast

2.2 MATERIALS, GENERAL

- A. Pipe Insulation:
 - 1. Glass Fiber:
 - a. Manville Micro Lok AP T Plus
 - 2. Hydrous Calcium Silicate:
 - a. Rigid, molded block, conforming to ASTM C533.

- b. Asbestos-free, color-coded throughout material. Coding shall remain stable throughout rated temperature range.
 - c. Thermal Conductivity (k Value): 0.40 at 300 degrees F.
 - d. Maximum Service Temperature: 1,200 degrees F.
 - e. Compressive Strength: Minimum of 160 PSI to produce 5% compression at 1-1/2 inch thickness.
 - f. Tie wires: 16 gauge stainless steel.
 - g. Manville Thermo 12/Gold
 3. Elastomeric Foam:
 - a. Flexible, cellular, molded or sheet; conforming to ASTM C534.
 - b. Thermal Conductivity (k value): 0.27 at 75 degrees F.
 - c. Maximum Service Temperature: 220 degrees F.
 - d. BBX, K-Flex acceptable for high temp applications to 300 deg F.
 - e. Connection Adhesive: Waterproof, vapor retarding, Rubatex R-373.
 - f. UV protective coating: Water-based latex enamel paint. Rubatex 374.
 - g. Insulation Tape: Elastomeric thermal insulation tape with closed-cell structure.
 - h. Rubatex R-180-FS/R-1800-FS,.
 4. Cellular Glass:
 - a. Waterproof, closed cell, rigid insulating material composed of sealed glass cells conforming to ASTM C552.
 - b. Thermal Conductivity (k value): 0.35 at 75 degrees F.
 - c. Density: 8 pounds per cubic foot.
 - d. Water-vapor Permeability: 0.005 perm-inch.
 - e. Pittsburgh Corning Foamglass.
- B. Field Applied Pipe and Fitting Jacketing:
 1. PVC Plastic: One-piece, UV-resistant, 20-mil thick, molded type, gloss white finish with fiberglass insulation insert for fittings.
 - a. Manville Zeston 2000 (indoors).
 - b. Manville Zeston 300 (outdoors).
 2. Aluminum:
 - a. 0.016-inch thick sheet with smooth or embossed finish, longitudinal slip-joints with 2-inch laps.
 - b. Sealant: Weatherproof.
 - c. Fitting covers: Die shaped with factory attached protective liner.
 3. Canvas:
 - a. Plain weave cotton treated with fire-retardant lagging adhesive.
 - b. Weight: 6 ounces per square yard.
 - c. UL listed fabric.
 4. Stainless Steel:
 - a. 0.010-inch thick, type 304 stainless steel with smooth or corrugated finish.
- C. Duct Insulation:
 1. Flexible Fiberglass Blanket:
 - a. ASTM C553, Type 1, Class B-3.
 - b. Thermal Conductivity (k value): 0.25 at 75 degrees F.
 - c. Density: 1.0 pounds per cubic foot.
 - d. Vapor barrier jacket: Aluminum foil reinforced with fiber-glass yarn and laminated to fire-resistant Kraft (Foil Scrim Kraft).
 - e. Manville Microlite.
 2. Rigid Fiberglass Board: Not allowed.
 3. Interior duct lining allowed only for sound attenuation at ventilation system terminal units. Insulation shall be installed only on the leaving side of the terminal box, and in quantities of less than six lineal feet.
- D. Duct Jacketing:

1. Canvas:
 - a. Plain weave cotton treated with fire-retardant lagging adhesive.
 - b. Weight: 6 ounces per square yard.
 - c. UL listed fabric.
 2. Outdoor Duct Jacketing:
 - a. Aluminum: 0.016-inch thick sheet with smooth or embossed finish, longitudinal slip joints with 2-inch laps.
 - b. Non water-vapor retarder: Non-burning, weatherproof coating, Manville Insulkote ET.
 - c. PVC plastic: 30mil thickness, UV resistant, Manville Zeston, 300 Series.
- E. Duct Liner (allowed for sound attenuation only, 6 lineal feet, at leaving side of terminal units. Duct liner is not allowed in lab air supply):
1. Round Duct Liner:
 - a. Rigid material, conforming to ASTM C427.
 - b. Thermal Conductivity (k value): 0.23 at 75 degrees F.
 - c. Noise Reduction Coefficient: ASTM C423, minimum of 0.70 based on type-A mounting.
 - d. Velocity rating: Minimum of 4,000 feet per minute.
 - e. Manville Spiracoustic.
- F. Equipment Insulation:
1. Flexible Fiberglass Blanket:
 - a. ASTM C612, Class 1.
 - b. Thermal Conductivity (k value): 0.24 at 75 degrees F.
 - c. Maximum Service Temperature: 450 degrees F.
 - d. Density: 1.5 pounds per cubic foot.
 - e. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft paper.
 - f. Manville 812 Spin-Glass.
 2. Rigid Fiberglass Board:
 - a. ASTM C612, Class 1 or Class 2.
 - b. Thermal Conductivity (k value): 0.23 at 75 degrees F.
 - c. Maximum Service Temperature: 450 degrees F.
 - d. Density: 3 pounds per cubic foot.
 - e. Vapor Retarder jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper.
 - f. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.
 - g. Manville 814 Spin-Glas.
 3. Rigid Fiberglass Board (High Temp):
 - a. Non-combustible, conforming to ASTM C612, Class 3.
 - b. Thermal Conductivity (k value): 0.23 at 75 degrees F.
 - c. Maximum Service Temperature: 850 degrees F.
 - d. Density: 3 pounds per cubic foot.
 - e. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.
 - f. Manville 1000 Spin-Glass.
 4. Cellular Glass:
 - a. ASTM C552.
 - b. Thermal Conductivity (k value): 0.35 at 75 degrees F.
 - c. Density: 8 pounds per cubic foot.
 5. Hydrous Calcium Silicate:
 - a. Rigid, molded block, conforming to ASTM C533.
 - b. Asbestos-free color-coded throughout material. Coding shall remain stable throughout rated temperature range.
 - c. Thermal Conductivity (k value): 0.40 at 300 degrees F.
 - d. Maximum Service Temperature: 1200 degrees F.
 - e. Compressive strength: Minimum of 160 PSI to produce 5% compression based on 1-1/2 inch thickness.

- f. Manville Thermo-12/Gold.
- G. Tank Insulation:
- 1. Flexible Fiberglass Board:
 - a. Thermal Conductivity (k value): 0.35 at 200 degrees F.
 - b. Maximum Service Temperature: 650 degrees F.
 - c. Density: 3 pounds per cubic foot.
 - d. Vapor Retarder Jacket: Pressure sensitive, self-sealing tape lap system of white kraft paper reinforced with glass fiber yarn and bonded to aluminum foil.
 - e. Manville Pipe and Tank Insulation.
- H. Steam Valve Insulation:
- 1. Material:
 - a. Insulation: Fiberglass
 - b. Inner jacketing: Teflon coated Nomex cloth.
 - c. Gussets: Teflon coated Nomex cloth.
 - d. Outer jacketing: Teflon coated Nomex cloth.
 - e. Sewing Thread: Stainless steel using lock stitch with seven stitches per inch.
 - f. Seam Fasteners: Teflon belts with stainless steel double D-rings and Velcro tabs.
 - g. Terminal Ends: Teflon coated Nomex cloth flaps with Teflon coated Nomex cloth drawcord.
 - h. Hardware: 304 stainless steel.
 - i. Maximum Service Temperature: 500 degree F, wet or dry environment.
 - j. Secure insulation within the jacketing with stainless steel quilt pins. Secure covers with cinch belts. Teflon belts with two stainless steel D-ring fasteners.
 - k. Belts secured to cover with Velcro hook-and loop-fasteners.
 - l. Advance Thermal Corporation.
- I. Fire-stop Insulation:
- 1. Flexible blanket, amorphous wool:
 - a. Thermal Conductivity (k value): 0.85 at 1000 degrees F and 1.70 at 1800 degrees F
 - b. Continuous use-temperature rating: 1834 degrees F
 - c. Melting point: 2327 degrees F
 - d. Density: 6 pounds per cubic foot.
 - e. Thermal Ceramics SF607.
- J. Fixed and Removable Valve Insulation:
- 1. Insulate valves, strainers and other equipment on steam, condensate, and hot water lines.
 - 2. Steam and Hot Water Valves:
 - a. 3 inch and larger: Insulate with removable insulation jacket.
 - b. 2-1/2 inch and smaller: Do not insulate unless removable type is shown to be cost effective or effect of heat loss is shown to be detrimental.
 - 3. Removable Insulation Jackets:
 - a. 1 inch thick fiberglass insulation.
 - b. Density: 9 to 11 lb. Pcf.
 - c. Maximum Service Temperature: 1000 degree F.
 - d. Secure with stainless steel quilting pins.
 - e. Inner and Outer Jacket: Silicone coated fiberglass, 34 oz. per sq. yard, chemical resistant, suitable for temperatures to 500 degree F.
 - f. Seam Closure: Teflon coated fiberglass threads suitable for temperatures to 600-degree F. of type 20 lb. Tensile strength.
 - g. Fastening System: Type 304 stainless steel double D-rings with silicone coated fiberglass belts with Velcro on ends. 1-inch wide belt sewn to adjacent insulation, flanges, etc. Stainless steel wire cords, minimum 1/4 inch diameter and Teflon coated.
 - h. Identification: Furnish type 304 stainless steel or aluminum I.D. tag riveted to jacket with item description, location and factory number.

- K. Utility Vault Pipe Insulation
 - 1. Steam and condensate line insulation
 - a. Closed-cell fiberglass
 - b. All insulation surfaces shall be protected by metal jacketing
 - 2. Chilled water supply and return insulation
 - a. Closed-cell fiberglass
 - b. Required insulation thickness
 - c. All insulation surfaces shall be protected by metal jacketing

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL:

- A. Overview:
 - 1. Install insulation only after piping, ducts, and equipment have been tested and approved by the Project Manager, and after all other tests and certifications which are required by the specifications have been satisfactorily completed.
 - 2. Continue insulation vapor barriers through penetrations except where prohibited by code.
 - 3. Install pipe and duct insulation continuous through wall and floor openings except where the penetrated surfaces or assemblies are fire-resistance rated. Provide fire-stop insulation at penetrations of fire-rated surfaces and assemblies. Maintain fire-resistance ratings of penetrated surfaces and assemblies.
 - 4. Install insulation on cold surfaces with a continuous, unbroken vapor seal. Insulate and vapor seal supports and anchors, which are directly secured to cold surfaces.
 - 5. Seal all exposed raw edges of insulation with vapor retarder or finishing cement.
 - 6. Do not use staples on vapor barrier jackets. Where staples must be used, thoroughly seal the vapor barrier penetrations with a white vapor-barrier finish. The Engineer prior to installation must approve use of staples.
 - 7. Do not weld insulation support pins to pressure vessels.
 - 8. Leave all insulation surfaces dry and clean, and ready for subsequent work.
- B. Installation of Piping Insulation:
 - 1. Install insulation and covers with seams in the least visible location.
 - 2. Neatly finish insulation at supports, protrusions, and interruptions.
 - 3. Verify piping wells and P & T taps are extended so that they will be flush with the surface of the finished insulation.
 - 4. Insulated dual-temperature piping systems and for insulated piping conveying fluids of a temperature less than the ambient temperature: Install vapor-retardant jacket with self-sealing lap joints. Insulate the complete systems.
 - 5. Insulated piping conveying fluids of a temperature greater than the ambient temperature: Install vapor-retardant jacket with self-sealing lap joints. Bevel and seal ends of insulation at equipment, flanges, and unions.
 - 6. Piping conveying cold fluids: Insulate continuous through hangers. Install rigid insulation inserts at pipe hangers and supports. Butt inserts tight to insulation. Apply a wet coat of vapor-barrier lap cement on butt joints and seal the joints with three-inch wide vapor-barrier tape or band.
 - 7. Install calcium silicate insert between support shields and piping for piping 1-1/2 inches and larger. Inserts shall not be less than the following lengths:

Pipe Size Inches	Insert Length Inches
1-1/2	6
2 through 9	9
10 through 14	12
16 through 24	18

8. Exposed piping in mechanical equipment rooms and exposed piping within 10 feet of the finished floor in finished spaces: Install PVC jacket and fitting covers or aluminum jacket.
 9. Exterior applications: Install PVC jacket and fitting covers or aluminum jacket over insulated pipe, fittings, joints, and valves. Locate jacket seams on bottom side of horizontal piping. Cover all valves, flanges, unions, accessories, and fittings with aluminum jacket. Seal jacket watertight and secure with lock type aluminum bands.
 10. Refrigerant piping insulated with elastomeric insulation: Seal joints with elastomeric sealant made by same manufacturer as the insulation. For outdoor locations, paint insulation white or silver. Paint shall be compatible with the insulation.
 11. Piping under concrete slabs on grade: Spiral wrap insulation with Protecto Wrap 200 coating with 50% overlap. Lay the insulated and wrapped piping on a 3-inch bed of sand and cover with 3 inches of sand all around.
- C. Installation of Blanket Insulation:
1. Apply insulation with edges tightly butted. Overlap facing at least two inches at joints. Seal joint in vapor seal with fire-retardant adhesive. Secure insulation to duct with approximately four-inch wide fire-retardant adhesive spaced at 8 inches on center
 2. Ducts Exceeding 30 Inches in Width: Install mechanical fasteners at 18 inches on center for the underside insulation in addition to the adhesive. Cut off the protruding ends of the fasteners flush after speed clips are installed and seal with vapor tape or mastic.
 3. Insulated ducts conveying air of a temperature less than the ambient temperature: Install vapor retardant jacket. Seal jacket seams and penetrations with UL listed tape or vapor retardant adhesive.
 4. Insulated ducts conveying air of a temperature greater than the ambient temperature: Bevel and seal ends of insulation where service access is required.
 5. Ducts Subject to Physical Abuse in Mechanical Equipment Rooms and Finished Spaces: Install PVC or aluminum jacket.
 6. Outdoor Applications: Install insulation with a weather protection jacket.
- D. Installation of Equipment Insulation:
1. Apply insulation as close as possible to equipment. Groove, score, and bevel insulation as necessary to achieve a tight fit. Secure insulation to equipment with studs, clips, pins, adhesive, wires, or bands as appropriate for the application. On cold equipment, do not use securing methods that penetrate the vapor barrier
 2. Fill joints, cracks, seams, and depressions with bedding compound. Form smooth surfaces. On cold equipment, use vapor retardant cement.
 3. Insulated dual-temperature equipment and for insulated equipment that contains fluids of a temperature less than the ambient temperature: Install vapor retardant jackets.
 4. Insulated equipment that contains fluids of a temperature greater than the ambient temperature: Install jacket with or without vapor barrier.
 5. Cover insulation with metal mesh and finish with heavy coat of insulating cement, mastic, or aluminum jacket.
 6. Do not insulate over nameplates, ASME stamps or UL labels. Bevel and seal insulation around nameplates and labels.
 7. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation so that it can be easily removed and replaced without damage.
- E. Installation of Insulation on Fittings and Valves:
1. Factory premolded one piece PVC insulated fitting covers: Use factory precut insulation applied to the fitting using two layers for pipe temperatures above 250 degrees F or below 35 degrees F, single layer insulation is acceptable between 35 degrees F and 250 degrees F. Tuck the ends of the insulation snugly into the throat of the fitting and the edges adjacent to the pipe covering, tufted and tucked in, fully insulating the pipe fitting. Covers shall overlap the adjoining pipe insulation and jackets, and on cold pipes seal at all seam edges with vapor barrier adhesive. Seal circumferential edges of all covers with pressure sensitive vinyl tape. The tape shall overlap the jacket and the cover at least one inch.

2. Where PVC covers are prohibited: Use as an alternate one of the following methods: aluminum covers, one coat insulation cement, premolded fiberglass fitting covers, or mitered segments of pipe insulation. Finish for non-PVC or aluminum shall be glass fabric embedded in fire retardant mastic lapped 2 inches over piping insulation. Finish with second coat of mastic. Mastic shall be vinyl acrylic mastic Childers CP-11 for hot piping and shall be Childers CP-30 or Fosters 30-35 or equal for cold piping.
 3. Valves may be insulated with sections of fiberglass pipe insulation complete with All Service Jacket. Raw ends shall be coated with vinyl acrylic mastic Childers CP-11 for hot piping or shall be coated with vapor barrier mastic Childers CP-30 or Fosters 30-35, or equal for cold piping.
 4. Insulate balancing cocks, strainer drains, hose bibs, and equipment requiring periodic maintenance with segmental insulating with an integral vapor barrier. Insulation and vapor barrier shall be easy to remove and replace.
- F. Installation of Engine Exhaust and Breeching Insulation:
1. Install calcium silicate insulation on engine exhaust and breeching.
 2. Install two layers of calcium silicate. Tightly butt and stagger joints. Secure with 16-gauge galvanized or stainless steel wire, or 1/2-inch by .015-inch galvanized steel bands. Install supports 12 inches maximum on center.
- G. Installation of Tank Insulation:
1. Wrap insulation around tank and secure with self sealing longitudinal laps and butt strips, or all-purpose jacket with outward clinch expanding staples on maximum 4-inch centers. Remove two segments of insulation to provide for lap.
 2. Cut circular sections for top and bottom of tank and insert inside of tank wrap.
 3. Seal all longitudinal and circumferential joints with 3 inches wide pressure sensitive tape.
 4. Apply vapor retarder mastic to all joints and staples.
- H. Installation of Fire-stop Insulation:
1. Install per listing.
- I. Installation of Steam and Hot Water Valves Insulation:
1. Provide custom fabricated insulated jackets for all valves and fittings.
 2. Fabricate inner and outer jacketing for exposure to steam leaks on medium and high-pressure steam systems. Jacketing shall retain full flexibility after an exposure from minus 50 degrees F to plus 500 degrees F.
 3. Construct and install covers to shed water. Locate closing seams at the gravitational bottom. Closely contour removable covers, ensure neat appearance and thermal performance. Individual covers or cover sequents shall not weigh more than 60 pounds.

END OF SECTION 23 07 00