

SECTION 15250

MECHANICAL INSULATION

PART 1 – DESIGN DIRECTIVES

1.1 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products, of types and sizes required, whose products have been in satisfactory use in similar services for not less than 10 years.
- B. Installer's Qualifications: Firms with at least 5 years successful installation experience on projects with mechanical insulation systems similar to that required for this project.
- C. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame-spread index of 25 or less, and smoke developed index of 50 or less, as tested by ASTM E 84 (NFPA 255) method.

1.2 DESIGN CRITERIA

- A. Insulation value shall conform with the latest edition of the New Hampshire Energy Code and ASHRAE recommendations.
- B. The designer is to clearly identify in the specifications the intended operating temperatures of each of the operating systems. Where piping systems serve multiple temperature ranges (ie, two pipe chilled/hot water systems), the insulation thickness shall be determined by the more stringent requirement, and the type of installation procedure (hot versus cold piping system) shall be clearly stated. Insulation installed on piping systems with an operating temperature less than ambient shall be considered as a cold piping system.
- C. Consult with DC-FO&M for insulation type, thickness, and cover for pipes entering a building (steam, condensate, or chilled water) via a non-direct burial system.
- D. Plastic foam insulations (i.e. polyurethane foam) is limited to exterior use only.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products of one of the following:
 - 1. Armacell LLC
 - 2. Certainteed Corp.
 - 3. Foster Products Corp.
 - 4. IMCOA
 - 5. Johns Manville Products Corp.
 - 6. Knauf Fiber Glass GmbH.
 - 7. Owens-Corning Fiberglas Corp.
 - 8. Pittsburgh Corning Corp.

2.2 PIPING INSULATION MATERIALS

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1, 'k' = 0.29 @ 150°F mean temperature.
- B. Calcium Silicate Piping Insulation: ASTM C 533, Type I, 'k' = 0.41 @ 200°F, 11#/cf density.
- C. Elastomeric Piping Insulation: ASTM C 518, C 177, E 96 (procedure A), & D 1056; Type I & II, 'k' = 0.27 @ 75°F mean temperature.
- D. Rigid Polyurethane Insulation: ASTM C 591, Type III, 'k' 0.14 new, 0.19 when aged 180 days. Minimum density 2.5#/cf, compressive strength 75 psi with 3% deformation.
- E. Pipe fittings:
 - 1. Fitting insulation shall be loose fill fiberglass ('fluffy') specifically fabricated for use with pre-molded PVC covers.
 - 2. Fitting insulation shall be molded fiberglass fabricated specifically for pipe size, type, and adjacent insulation thickness. Only molded products are acceptable. Products manufactured from mitered and glued from sections of straight run insulation or machine routed from flat stock board are unacceptable. Acceptable manufacturers:
 - a. HAMFAB Products, division of ICA Inc.

2.3 PIPE INSULATION COVER

- A. All Service Jacket (ASJ) cover shall be white kraft bonded to aluminum foil, fiberglass reinforced (ASTM E 96 (procedure A), D 781, & D 828). Pipe fitting covers shall be one-piece premolded PVC fitting covers, fastened as per manufacturer's recommendations with fiberglass inserts.
- B. Aluminum jacket pipe insulation shall be .010" thick, corrugated finish, with a one mil polyethylene film / forty pound kraft paper integral vapor barrier affixed to the interior of the cover in conformance with ASTM B-209.
- C. Two piece fittings shall be preformed and sized for the specified pipe & insulation thickness.
- D. Elastomeric insulation shall be covered with two coats of paint manufactured specifically for covering Elastomeric insulation, WB Armaflex Finish or equal.

2.4 DUCTWORK INSULATION MATERIALS

- A. Rigid fiberglass ductwork insulation shall conform to ASTM C 612, Class 1, 6.0 PCF density, 'R' = 6.6 @ 1.5" thickness, 75°F mean temperature.
- B. Flexible fiberglass ductwork insulation shall conform to ASTM C 553, Type I, Class B-4, 0.75 PCF density, out of package 'R' = 5.1 @ 1.5" thickness, 75°F mean temperature differential.
- C. Duct insulation cover shall be fiberglass reinforced foil and paper (Foil Scrim Kraft) jacket conforming with ASTM C 1136. Install per manufacturer's written instructions.

2.5 EQUIPMENT INSULATION MATERIALS

- A. Rigid fiberglass equipment insulation shall conform to ASTM C 612, Class 2, 6.0 PCF density, 'k' = 0.23 @ 75°F mean temperature. cover insulation with pre-sized glass cloth jacketing material, not less than 7.8 ounces per square yard. Provide a trowel or glove grade water based general

purpose mastic (white or light gray) suitable for interior or exterior applications. Install per manufacturer's written installation instructions..

2.6 WEATHERPROOFING

- A. Self adhering cover: Membrane shall be a pre-manufactured self adhering product with an UV resistant, stucco embossed facing. Water vapor transmission of the installed product shall be .020 perms or less. Product shall be suitable for continuous use in low temperatures of -10°F. Manufacturers shall be Flex-Clad 400, MFM Building Products Corp. or Alumaguard 60, Polyguard Products, Inc.
- B. Non-self adhering cover: Mechanically attached EPDM roofing membrane.

PART 3 – EXECUTION

3.1 HVAC AND PLUMBING PIPING INSULATION

- A. The International Energy Conservation Code 2000 permits energy conservation using the IEC parameters or the parameters in ASHRAE 90.1 – 2001. For the purpose of pipe insulation thickness, Dartmouth College has chosen to adhere to the requirements of ASHRAE 90.1. If this is part of a project that requires a compliant statement from the designer, the IEC parameters may need to be followed depending if the designer is using the IEC for compliance measures. Insulate HVAC and plumbing piping systems with insulation according to the following schedules:

Pipe Insulation Systems			
Pipe Service	Location	Insulation Type	Insulation Cover
Steam	Building	Fiberglass	ASJ
Steam Condensate	Building	Fiberglass	ASJ
Chilled Water	Building	Fiberglass	ASJ
Condenser Water	Building	Fiberglass	ASJ
Domestic Hot Water	Building	Fiberglass	ASJ
City Water	Building	Fiberglass	ASJ
Refrigeration Piping	Building	Elastomeric	None
	Exterior	Elastomeric	Paint
Storm Water	Building	Fiberglass	ASJ
Steam	Distribution Manhole	Calcium Silicate	Aluminum Jacket
Chilled Water	Distribution Manhole	Polyurethane	Aluminum Jacket
Steam	Exterior above grade	Calcium Silicate	Aluminum Jacket
Chilled Water	Exterior above grade	Polyurethane	Aluminum Jacket

Minimum Pipe Insulation Thickness - Fiberglass or Polyurethane							
Fluid Design Operating Temperature, °F	Conductivity Range (k) (Btu*in/(h*cf*°F))	Nominal Pipe Diameter (inches)					
		Runouts <2 diameter & 12' long	<1	1 → <1-1/2	1 1/2 → <4	4 → <8	≥8
251→350	0.29-0.31	1.5	1.5	2.5	3.0	3.0	3.0
201→250	0.27-0.30	1.5	1.5	1.5	2.0	2.0	2.0
141→200	0.25-0.29	0.5	1.0	1.0	1.0	1.5	1.5
105→140	0.24-0.28	0.5	0.5	0.5	1.0	1.0	1.0
61→104		0	0	0	0	0	0
40→60	0.23-0.27	0.5	1.0	1.0	1.0	1.0	1.0
<40	0.23-0.27	1.0	1.0	1.5	1.5	1.5	1.5

1. The Minimum Pipe Thickness chart shall be used for insulations with the scheduled 'k' values. Insulation thickness of insulation with 'k' values outside of the schedule (i.e. calcium silicate) shall be computed via the formula noted in ASHRAE Standard 90.1 - 2001.
- B. Plumbing piping system insulation omitted on chrome plated exposed piping (except for handicapped fixtures), air chambers, unions, etc.
 1. Special Application Requirements: Insulate interior above-ground horizontal storm water piping, 1" thickness.
 2. Insulate all exposed piping under ADA compliant lavatories with a white, fitted anti-microbial pipe cover. Cover shall be designed to allow access to the stop valves. Lav Guard; Truebro, Inc
- C. HVAC piping system insulation omitted on steam traps, on condensate piping between steam trap and union, hot piping within radiation enclosures or unit cabinets; on cold piping within unit cabinets provided piping is located over drain pan; and on unions, flanges, flexible connections, and expansion joints.
 1. Insulate low temperature refrigerant piping (liquid line) with 1 1/2" thick elastomeric insulation and cold condensate drains from refrigeration and air conditioning drain pans with 1" thick fiberglass insulation.

3.2 DUCTWORK SYSTEM INSULATION

- A. Do not insulate lined / double walled ductwork, return air ductwork within a building, and exhaust air ductwork.
- B. Insulate outdoor air intake ductwork between exterior air terminal and isolation damper with rigid insulation.
- C. Insulate all supply ductwork between HVAC units and room terminal outlets with flexible fiberglass.

3.3 EQUIPMENT INSULATION

- A. Application Requirements: Insulate the following cold (below ambient) equipment:
 - 1. Refrigeration equipment, including chillers, tanks and pumps.
 - 2. Drip pans under chilled equipment.
 - 3. Cold water storage tanks.
 - 4. Cold and chilled water pumps.
 - 5. Pneumatic water tanks.
 - 6. Roof drain bodies.
 - 7. Air separators

- B. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
 - 1. Fiberglass: 2" thick for cold surfaces above 35°F and 3" thick for surfaces 35°F and lower. Provide a vapor barrier cover of cloth and mastic or aluminum cover.
 - 2. Elastomeric: 2" thick for refrigeration piping and devices in chilled water piping systems.

- C. Application Requirements: Insulate with 2" thick rigid fiberglass the following hot (above ambient temperature) equipment:
 - 1. Hot water storage tanks.
 - 2. Heat exchangers.
 - 3. Condensate receivers.
 - 4. Hot water pumps.
 - 5. Fuel oil heaters.
 - 6. Air separators.

3.4 INSTALLATION OF HOT PIPING INSULATION

- A. After installation of heat tracing, painting, testing, and acceptance of tests, install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

- B. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage

- C. Cover valves, fittings, and similar items in each piping system $\leq 2"$ with equivalent thickness and composition of insulation as applied to adjoining pipe run. PVC Pipe fittings shall be utilized at all fittings. Install factory molded or job fabricated removable units on all valves over 2".
 - 1. Install 'fluffy' insulation at the pipe fittings under the PVC fitting.

- D. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where penetrations go through fire rated construction. At fire rated construction, install insulation only if allowed by the fire stop detail.

- E. Cover exposed ends of fiberglass with a vapor retardant mastic.

- F. Butt pipe insulation against pipe hanger insulation inserts. Apply 3" wide vapor barrier tape or band over the butt joints

- G. Fasten aluminum jacket to insulation using strapping and wing seals of the same material as the cover. In exterior applications, insure that all seams are watertight. Follow manufacturer's written installation guidelines.

- H. Install a polyurethane insulation insert at hangers on all piping 2" and larger. Insert material shall be at least as long as the protective shield.

3.5 INSTALLATION OF COLD PIPING INSULATION

- A. After painting, testing, and acceptance of tests, install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose. Insulation must be applied so there are no voids between the inner insulation face and the cold piping system. The insulation system must be installed in such a manner that the piping system will not condense.
- B. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage. Special care must be made to maintain the vapor barrier at PVC fittings and with pipe covered with aluminum jackets.
- C. Cover valves, fittings and similar items in each piping system with insulation as applied to adjoining pipe run. Extra care must be taken on piping appurtenances to insure a tight fit to the piping system. Valve extension stems require elastomeric insulation that is tight fitting to the adjoining fiberglass system insulation. Pumps, strainers, air separators, drain valves, etc. must be totally encapsulated with elastomeric insulation.
 - 1. Install fabricated molded insulation inserts at the pipe fittings under the PVC fitting.
- D. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where penetrations go through fire rated construction. At fire rated construction, stop insulation at each side of the penetration, fill the interstitial space between the fire caulk with mineral wool (or other approved material), and seal penetration to maintain fire rating.
- E. Cover exposed ends of fiberglass with a vapor retardant mastic.
- F. Elastomeric Insulation:
 - 1. Glue the butt ends of insulation to each other to form a homogenous membrane maintaining the vapor barrier.
 - 2. Exterior elastomeric insulation shall be installed with the longitudinal seam on the bottom of the pipe and shall be protected with an ultra violet resistive paint.
- G. Butt pipe insulation against pipe hanger insulation inserts. Apply wet coat of vapor barrier lap cement on butt joints and over staples and seal joints with 3" wide vapor barrier tape or band.
- H. Fasten aluminum jacket to insulation using strapping and wing seals of the same material as the cover. In exterior applications, insure that all seams are watertight. Follow manufacturer's written installation guidelines.
- I. Install a polyurethane insulation insert at hangers on all piping 2" and larger. Insert material shall be at least as long as the protective shield.

3.6 INSTALLATION OF DUCTWORK INSULATION

- A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves the intended purpose.

- B. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage. Where punctures occur, patch tears with a tape of the same facing. Excessive damage will require the insulation to be replaced.
- C. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where penetrations go through fire rated construction.
- D. Protect insulation on exterior ductwork from weather by installing outdoor protective finish or jacketing as recommended by manufacturer.

3.7 INSTALLATION OF EQUIPMENT INSULATION

- A. Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves the intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover fiberglass insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- H. Do not insulate manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. 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.
- J. Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

END OF SECTION 15250