

DESIGN REQUIREMENTS

MECHANICAL INSULATION

GENERAL INFORMATION

- 1.1 Comply with more stringent of following latest edition of Energy Conservation and Construction Code of New York City, ASHRAE and this Guideline.

DESIGN REQUIREMENTS

2.1 Insulation for Equipment

a. Tank Enclosures and Accessories

1. Semi-rigid tank insulation shall be 3 lb/ft³ density glass fiber insulation with a maximum thermal conductivity of 0.30 BTU/hr-ft²-°F.-in, as a mean temperature of 200°F., unfaced.

Service	Minimum Thickness
Inline air separators	2"
Irregularly shaped pipe accessories	2"
Shell and tube heat exchangers	3"
Domestic water storage tank	2"
Condensate pump receivers	2"
Expansion tank	2"
Flash tank	2"

2. Point joints with lagging cement prior to application of finish. Finish with two layers of 8 oz. glass mesh weave. Coat each layer with vapor barrier adhesive.
3. Insulation shall be fastened with welded pins or stick clips on flat surfaces and with stainless steel bands on irregular surfaces. Note: Do not weld attachment pins to ASME rated heat exchangers.
4. Provide removable insulation segments at heat exchanger heads to allow removal and reinstallation of tube bundles.

DESIGN REQUIREMENTS

b. Pump Enclosures (Chilled Water, Secondary Water, Condenser Water)

1. Encase pumps in No. 20 gauge removable aluminum (or 18 gauge galvanized) cover lined with two inch thick 6 lb/ft³ density rigid glass fiber insulation with a maximum thermal conductivity of 0.30 BTU/hr-ft²-°F.-in at a mean temperature of 75°F.
2. Fabricate the enclosure with a division coinciding with the pump split case so that part of the enclosure can be removed and the pump serviced and dismantled without destroying the insulation.
3. Fill voids in the interior of the insulated enclosure with scraps of fiberglass insulation.
4. Vapor seal closure joints of metal casing.

c. Chillers, Absorbers and Boilers

1. Manufacturer of equipment shall provide factory installed and applied insulation on all hot and cold surfaces.
2. Water Boxes
 - a) Insulate water boxes with one inch thick closed cell panel cut and mitered to conform to the water box geometry. Spacing behind flange plate shall have insulation built up to height equal to that of the flange plate with minimum width of 3".
 - b) Prefabricate removable, 20 gauge aluminum cover for water box head plate, lined with 1" thick closed cell panel. Cover shall be constructed for a snug fit over water box flanges to a point even with built up insulation behind flange plate.
 - c) Vapor seal fixed closure joints of metal cover.

2.2 Insulation for Pipe and Fittings

Insulation Thickness and Type				
Service	Pipe Size	Thickness	Runouts*	Type
High Pressure Steam (above 15 psig)	Up to 1½"	2½"	-	A
	2" & Larger	3"	-	A
Low Pressure Steam (15 psig & below)	Up to 1½"	1½"	1½"	B
	2" & Larger	3"	3"	B
Steam Condensate Return (above 15 psig)	Up to 1½"	1½"	-	A
	2" & Larger	3"	-	A
Steam Condensate Return	Up to 1½"	1½"	1½"	B

DESIGN REQUIREMENTS

Insulation Thickness and Type				
Service	Pipe Size	Thickness	Runouts*	Type
(15 psig & below) Pumped Condensate Hot Water (Heating)	2" & Larger	2"	2"	B
Chilled Water	Up to 1½"	1½"	1½"	C
	2" & Larger	1½"	1½"	C
Refrigerant	Up to 1½"	1"	-	D
	2" & Larger	1½"	-	D
AC Unit Drains and other piping subject to sweating	All	¾"	-	C

*Runouts are piping directly connected to a terminal unit and not exceeding 6'-0" in length.

a. Type A Calcium Silicate For Hot Pipes

1. All high pressure (above 15 psig) steam and condensate return piping and fittings shall be insulated with 11 lb/ft³ calcium silicate insulation with a thermal conductivity of 0.41 at 200°F. mean temperature. Glass cloth shall be applied on insulation with an approved adhesive and secured with aluminum bands 12" on center.
2. Insulate fittings, flanges, valves, etc. for services where calcium silicate insulation with mineral wool cement of equal thickness to the pipe insulation and finished with glass cloth. Provide aluminum outer jacket for all piping including fittings, valves, etc.

b. Type B Glass Fiber For Hot Pipes

1. Insulation shall be glass fiber with a maximum thermal conductivity of .24 at 75°F. mean temperature with factory applied all-service jacket.
2. Insulation shall be rigid, molded, one-piece, fiberglass insulation that is bonded with thermosetting resin, similar to Manville Micro-Lok with AP-T Plus Jacket.
3. The longitudinal lap of the All Purpose Jacket shall have a pressure sensitive tape lap sealing system. Butt joints shall be sealed using manufacturer supplied butt strips.
4. Insulation shall be capable of continuous service at a pipe temperature of 450°F. without oxidation, burnout of binders, or development of odors or smoke.

DESIGN REQUIREMENTS

5. All fittings, valves, flanges and pipe terminations.
 - a) Where manufactured, use factory premolded fittings (of the same material and thickness as the pipe insulation) for fittings, flanges and valves. Provide PVC fitting cover.
 - b) Where premolded insulation fittings are not manufactured, insulate fittings, flanges and valves with mitered segments of the same density as the adjoining pipe covering.
 - c) Flange insulation shall extend a minimum of 1" beyond the end of the bolts, and the bolt area shall be filled with mineral wool cement.
- c. Type C Glass Fiber For Cold Pipes
 1. Same material and application techniques as Type B with the following addition.
 - a) Vapor Barrier Jacket: Seal longitudinal joints with vapor barrier adhesive, transverse joints sealed with vapor barrier strips and adhesives. Ends of pipe insulation sealed off with vapor barrier adhesive at all flanges, valves and fittings, and at not more than 20' on continuous runs of pipe.
 2. 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.
 3. 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.
 4. All fittings, valves, flanges and pipe terminations
 - a) Where manufactured, use factory premolded fittings (of the same material and thickness as the pipe insulation) for fittings, flanges and valves. Provide PVC fitting cover.
 - b) Where premolded insulation fittings are not manufactured, insulate fittings, flanges and valves with mitered segments of the same density as the adjoining pipe covering.
 - c) Flange insulation shall extend a minimum of 1" beyond the end of the bolts, and the bolt area shall be filled with mineral wool cement.

DESIGN REQUIREMENTS

5. Vapor Barrier is to be maintained at all riser clamps and pipe hangers.
 - a) Vapor dam insert is to be used every 9' in vertical risers.
 - b) When staples are used to seal insulation joints, staples MUST be covered by CP-11.

d. Type D Foam Insulation

1. Insulation shall be premolded flexible elastomeric foam plastic with 2 lb/ft³ density and maximum thermal conductivity of .030 at mean temperature of 100°F. suitable operating range between -40°F. to 200°F.
2. Slip pipe insulation over pipe or slit the insulation and apply around pipe. Insulate fittings and valves with fabricated covers of some thickness. Miter all joints and seal with adhesive. Longitudinal seams to be located on top centerline of pipe.

2.3 Insulation for Ductwork

- a. Supply air ductwork used for heating and/or cooling from air handling unit discharge to air distribution outlets shall be 1 ½" Type A for concealed ducts and 1" Type B for exposed ducts.
- b. Return ductwork in non-conditioned spaces shall be insulated similar to supply air ductwork. Return ductwork does not require insulation in ceilings of conditioned spaces.
- c. All outside air intake (OAI) plenums and ductwork shall be insulated with 2" Type B. Concealed Outdoor Air Intake ductwork outside confines of mechanical equipment room can utilize 2" Type A.
- d. All exhaust air plenums and ductwork shall be insulated with 2" Type B. Concealed exhaust discharge ductwork outside confines of mechanical equipment room can utilize 2" Type A.
- e. Type A Flexible Duct Insulation
 1. Flexible duct insulation shall be 1.5 lbs/ft³ density glass fiber insulation with a maximum thermal conductivity of 0.24 BTU/hr-ft²-°F.-in., at a mean temperature of 75°F. Insulation shall have a reinforced, foil-faced, flame-resistant, Kraft vapor barrier.
 2. Insulation shall be secured with duct adhesive and wire-wrapped on 12" centers. All joints shall be sealed by adhering a 2" sealing lap at all joints with vapor barrier adhesive or 3" strips of vapor barrier jacket applied with vapor barrier adhesive.

DESIGN REQUIREMENTS

f. Type B Rigid Duct Insulation

1. Rigid duct insulation shall be 4.2 lbs/ft³ density rigid glass fiber insulation, with a maximum thermal conductivity of 0.24 BTU/hr-ft²-°F.-in. at a mean temperature of 75°F. Insulation shall have a white reinforced foil vapor barrier facing.
2. Insulation shall be impaled over welded pins applied to duct surface on 12" to 18" centers. Use a minimum of two rows of fasteners on each side of duct. Secure insulation with suitable speed washers or clips firmly imbedded into insulation. All joints and breaks in the vapor barrier shall be sealed with 3" wide strips of the vapor barrier facing adhered with vapor barrier adhesive.

2.4 Insulation for High Temperature Applications Including Breeching, Kitchen Exhaust and Emergency Generator Exhaust Pipe

- a. Thickness is dependent upon exhaust temperature but no less than 4" thick.
- b. Secure insulation to breeching with a minimum No. 16 gauge galvanized wire of ½ inch galvanized strapping spaced 18 inches on centers maximum.
- c. Sections of equipment requiring periodic servicing shall be insulated with aluminum covers lined with the same thickness of material as the adjoining insulation.

2.5 Non-Fire-Rated Penetrations

- a. Wherever piping penetrates walls, partitions, floor slabs, etc., the space between the piping and the sleeve shall be packed with filler and sealed with type non-hardening compound.
- b. There shall be no insulation joints located within the wall penetrations.

2.6 Fire-Rated Penetrations

- a. Piping through fire-rated walls and slabs shall be provided with a pipe sleeve and the entire assembly shall comply with UL 1479. Refer to Firestopping Section.

2.7 Protection of Piping Insulation

- a. Protect pipe covering at hangers, guides, and roller supports with 16 gauge galvanized metal shields or saddles (at least 3 times the insulation diameter in length and 1/3 the insulation circumference in width) on the outside of the insulation and vapor barrier. Hold shields in place with straps. Do not pierce the insulation with hangers. Fill each pipe covering protection saddle with same insulation as specified for respective pipe or with suitable insulating cement.

DESIGN REQUIREMENTS

- b. Insulation “inserts” shall be installed at hangers for glass fiber insulated piping 3” and larger and as an option to reduce shield length on pipes below 3”. Inserts between the pipe and pipe hangers shall consist of either high density fiberglass (7 lb/ft³) or calcium silicate insulation of equal thickness to the adjoining insulation and shall be provided with vapor barrier where required. Inserts shall have sufficient compressive strength so that when used in combination with a sheet metal shield, they support the weight of the pipe and the fluid in it without crushing the insulation.

- c. Shield Lengths

Pipe Diameter	Shield Length With Insert	Shield Length Without Insert
3” and below	6”	12”
4” to 6”	8”	18”
8” and larger	12”	24”

- d. Inserts shall be a minimum of 6” longer than shield length, be half round where pipe is hung and full round where clamped. A second shield will be required on clamped pipes that have vapor barriers.
- e. Pipes Subject To Freezing and Piping Exposed to Outdoors: Cover any piping subject to freezing with an additional layer of 2” glass fiber insulation of the same finish scheduled for the particular service when not subject to freezing, but not less than 3” total thickness. Cover insulated piping exposed to outdoors in addition to finishes scheduled with an aluminum jacket similar to Manville “Metal-Lok” or as approved, including all fittings.
- f. Insulate heat-traced pipes as indicated for pipes subject to freezing. Cover with an aluminum jacket, as specified for piping exposed to the outdoors.
- g. Exposed insulated piping within 36” of a mechanical equipment room floor and other open areas subject to abuse such as parking garages shall be protected with an aluminum insulation jacket similar to “Johns-Manville” “Metal-Lok.”
- h. Insulation that may be in contact with chain operators for valves must be shielded.

CONSTRUCTION REQUIREMENTS

- 3.1 Insulation shall be applied to clean, dry surfaces. Do not install damaged insulation. Damaged insulation shall be removed from the job site. Any water-damaged insulation shall be removed and replaced by the Contractor at no additional cost.

DESIGN REQUIREMENTS

- 3.2 Insulation on cold surfaces where vapor barrier jackets are used shall be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, etc. that are secured directly to cold piping shall be adequately insulated and vapor sealed to prevent condensation.
- 3.3 The use of duct tape and/or aluminum wrap for patching insulation is prohibited.
- 3.4 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.
- 3.5 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.
- 3.6 Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
- 3.7 Do not apply insulation to equipment while hot or cold.
- 3.8 Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- 3.9 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.
- 3.10 Cover fiberglass insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.
- 3.11 Do not insulate manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- 3.12 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.
- 3.13 Protect outdoor insulation from weather by installation of weather-barrier mastic protective finish, or jacketing, as recommended by the manufacturer.
- 3.14 Insulation shall not be installed until the piping or duct system has been tested to the satisfaction of the University, and is signed off.



DESIGN REQUIREMENTS

- 3.15 Existing insulation damaged or removed shall be replaced with material and workmanship as that specified for the new work.
- 3.16 The use of duct tape for patching insulation is prohibited.
- 3.17 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.
- 3.18 Do not insulate lined or double wall ductwork

REFERENCE

- 4.1 The applicable CSI Specification Section is 23 07 00.