

SECTION 15250 - MECHANICAL INSULATION

PART 1 - GENERAL

1.1 QUALITY ASSURANCE:

- A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of mechanical insulation products and systems, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 3 years.
- B. Installer's Qualifications: Firm with at least 5 years successful installation experience on projects with mechanical insulations 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. In addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove that fire hazard ratings for materials proposed for use do not exceed those specified.

1.2 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, k-value, thickness, density, and furnished accessories for each mechanical system requiring insulation. Submit detail product information and installation information for all jacketing systems specified in this section.

1.3 DELIVERY, STORAGE, AND HANDLING:

- A. Deliver insulation, coverings, cements, adhesives, and coatings to site in containers with manufacturer's stamp or label, affixed showing fire hazard indexes of products.
- B. Protect insulation against dirt, water, and chemical and mechanical damage. Do not install damaged or wet insulation; remove from project site.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:

- 1. Mechanical Insulation:
 - a. Johns Manville Corp.
 - b. Owens-Corning Fiberglas Corp.
 - c. Knauf Fiber Glass
 - d. Manson
 - e. Armstrong World Industries, Inc.
 - f. Pittsburgh Corning Corp.
 - g. PABCO, Inc.
 - h. Rubatex Corp.
 - i. Thermal Ceramics
 - j. Thermal Structures

2. Jacketing & Covering Products:

- a. Childers
- b. Ceel-Co
- c. Zeston
- d. Alpha Associates, Inc.

3. Sound Lagging/Insulation

- a. Soundseal
- b. Vibro-Acoustics
- c. Schuller
- d. Owens-Corning
- e. Certainteed

2.2 PIPING INSULATION MATERIALS:

- A. Fiberglass Piping Insulation: ASTM C 547, Class 1 unless otherwise indicated. "K" factor shall be maximum 0.24 at 75 degrees F. mean temperature, jacket with tensile strength of 35 lbs/in, mullen burst 70 psi, beach puncture 50 oz. in/in, permeability .02 perm factory applied vapor barrier jacket and adhesive self-sealing lap joint.
- B. Cellular Glass Piping Insulation: ASTM C 552, Type II, Class 2. "K" factor shall be maximum 0.29 at 75 degrees F mean temperature.
- C. Calcium Silicate Piping Insulation: ASTM C 533, Type I. "K" factor shall be maximum 0.45 at 500 degrees F. mean temperature, compression strength 200 psi for 5 percent compression, transverse strength 200 psi for 5 percent compression, flexural strength 60 psi.
- D. Flexible Closed Cell Piping Insulation: ASTM C 534, Type I. "K" factor shall be maximum 0.27 at 75 degrees F. mean temperature, with a water vapor permeability of 0.10 perm inches or less. Insulation shall be pre-installed on piping, or un-slit to be slipped over piping as a single piece.
- E. Flexible Thermal Ceramic Insulation [[Fiber Retractory](#), [Ceramic Fiber](#)]: "K" factor shall be a maximum of 1.5 at 1500 degrees F mean temperature, 2000 degreeed F temperature limit. Provide presized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, unless otherwise indicated.
- F. Rigid Thermal Ceramic Insulating System: "K" factor shall be a maximum of 1.5 at 1500 degrees F mean temperature, 2000 degrees F temperature limit.

Edit Note: Rigid thermal insulating systems are designed to specific job applications by Thermal Structures. Provide desired thickness, ambient air temperature desired, cold side temperature, and hot side temperature to Thermal Structures for proper design of insulating system.

- G. Jackets for Piping Insulation: ASTM C 921, Type I for piping with temperatures below ambient, Type II for piping with temperatures above ambient. Type I may be used for all piping at Installers option.
- 1. Fitting Covers: UV resistant PVC, pre-molded fitting covers, flame spread 25, smoke developed 50. PVC tape for cold systems, serrated tacks or PVC tape for hot systems.

2. Aluminum Jacketing: Manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16" corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be .016" thick minimum. Provide matching factory fabricated covers for 90 degrees and 45 degrees elbows, tee fittings, flange fittings valve bodies, blind ends, reducers and other fittings necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.
3. PVC Jacketing: UV resistant PVC, 30 mil thick, flame spread 25, smoke developed 50, factory cut and curled to fit O.D. of insulated pipe. Solvent weld adhesive for sealing joints and seams.
4. Rubber/Tedlar Jacketing: ASTM-D-1424-63, ASTM-D-774, and ASTM-E-84, manufactured from a combination of heavy fiberglass fabric coated with Hypalon Rubber, fully cured and laminated to a Tedlar facing. Jacketing will also be required to be vapor barrier and shall be laminated to a corrosion resistant aluminized mylar. Jacketing shall be .010" thick minimum, UL Class I rated, acid and alkali resistant, and be both washable and paintable. Provide factory fabricated aluminum fitting covers with mil-polyethylene vapor barrier for all elbows, tees, flanges, valves, and other fittings. Alpha Associates Style TGH-1000 or equal.
5. Cloth Jacketing Material: Not less than 8 oz. per square yard with adhesives, cement and sealer as recommended by insulation manufacturer for the intended application. PVC premolded fitting covers shall not be provided.

H. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.

I. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated and additional finishes as specified.

2.3 DUCTWORK INSULATION MATERIALS:

- A. Rigid Fiberglass Ductwork Insulation: ASTM C 612, Class 1, 450 degrees F temperature limit, density of 3 pcf. "K" value shall be maximum 0.23 at 75 degrees F. mean temperature, facing of 7 mil, foil reinforced with glass mesh and laminated to 40 lb kraft.
- B. Round Surface Semi-Rigid Fiberglass Blanket Insulation: ATSM C 612, Class 1, 450 degrees F temperature limit, 2.5 PCF density "K" value of .25 max at 75 degrees F mean temp, foil-skrim-kraft facing. Orientation of fibers shall be perpendicular to facing to facilitate application on round surfaces.
- C. Flexible Fiberglass Ductwork Insulation: ASTM C 553, Type I, 3/4 lbs per cu. ft. density. "K" value shall be maximum 0.25 at 75 degrees F. mean temperature, 250 degreeed F temperature limit, vapor transmission rating shall not exceed 0.02 perms, facing of .7 mil foil reinforced with glass mesh and laminated to 40 lb kraft.
- D. Flexible closed cell elastomeric insulation: ASTM C534, Type I, "K" value shall be a maximum 0.27 at 75 degrees F mean temp, 220 degrees F Temperature limit, water vapor permeability rating of 0.10 perm inches or less.
- E. Jackets for Ductwork Insulation: ASTM C 921, Type I for ductwork with temperatures below ambient; Type II for ductwork with temperatures above ambient.

Edit Note: Coordinate exterior ductwork insulation spec with details on drawings. Carefully consider cost, durability, moisture resistance, and appearance. Metal jacket is best, and most expensive. Armaflex finish needs repainting every 3-5 years and cannot be applied below 50 degrees F. Coordinate with Architect and Owner.

1. Aluminum Jacketing: The jacketing shall be manufactured from T3003 (or T/5005) H14 to H19 aluminum alloy with 3/16 inch corrugations and shall have a factory attached 1 mil thick polyethylene moisture barrier continuously laminated across the full width of the jacketing. Jacketing shall be .016 inches thick minimum. Where available, provide matching factory fabricated covers for 90 degrees and 45 degrees elbows, tee fittings, branch fittings, reducers and other fittings necessary to make the covering system complete, waterproof and weatherproof. All jacketing shall be color coated baked on polyester finish, color selected by Architect.

OR

Rubber/Tedlar Jacketing: ASTM-D-1424-63, ASTM-D-774, and ASTM-E-84, manufactured from a combination of heavy fiberglass fabric coated with Hypalon Rubber, fully cured and laminated to a Tedlar facing. Jacketing will also be required to be vapor barrier and shall be laminated to a corrosion resistant aluminized mylar. Jacketing shall be .010" thick minimum, UL Class I rated, acid and alkali resistant, and be both washable and paintable. Provide factory fabricated aluminum fitting covers with mil-polyethylene vapor barrier for all elbows, tees, and other fittings. Alpha Associates Style TGH-1000 or equal.

OR

Flexible closed cell elastomeric insulation shall be coated with two coats Armstrong WB Armaflex Finish

- F. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- G. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.4 EQUIPMENT INSULATION MATERIALS:

- A. Rigid Fiberglass Equipment Insulation: ASTM C 612, Class 2. "K" factor shall be maximum 0.28 at 200 degrees F. mean temperature, 3.0 lb. density, 850 degrees F temperature limit.
- B. Flexible Fiberglass Equipment Insulation: ASTM C 553, Type I, "K" factor shall be maximum 0.45 at 250 degrees F. mean temperature. 850 degrees F temperature limit.
- C. Calcium Silicate Equipment Insulation: ASTM C 533, Type I, Block. "K" factor shall be maximum 0.87 at 1000 degrees F. mean temperature, compression strength 200 psi for 5 percent compression, transverse strength 60 psi.
- D. Flexible closed cell elastomeric insulation: ASTM C534, Type I, "K" valve shall be a maximum of 0.27 at 75 degrees F mean temp, 220 degrees F temperature limit, water vapor permeability of 0.10 perm inches or less.

- E. Jacketing Material for Equipment Insulation: Provide pre- sized glass cloth jacketing material, not less than 7.8 ounces per square yard, or metal jacket at Installer's option, except as otherwise indicated.
- F. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics and protective finishes as recommended by insulation manufacturer for applications indicated.
- G. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape, corner angles, anchors and stud pins as recommended by insulation manufacturer for applications indicated.

2.5 SOUND LAGGING/INSULATION:

- A. Flexible Fiberglass & Vinyl Sound Insulation: 1.0 PSF, .090 inch thick mylar feed vinyl loaded barrier, tested to 400psi tensile strength. Absorber material, foil covered fiberglass laminated on vinyl barrier, .40 PSF, 2 inch nominal thickness insulating value of R-8.0. Assembly flame/smoke index of 12.5/19.5 tested per Class A ASTM E-84. Assembly sound tested per ASTM E-90 for a STI of 30 or greater. Rated for temperature between -20 degrees F & 350 degrees F. Provide soundseal B-10LAG/AFA-9 or approved equal.

SOUND TRANSMISSION LOSS (dB) FREQUENCY (Hz)						
PRODUCT	125	250	500	1000	2000	4000
B-10 LAG 1 QFA-9	19	20	23	33	44	53

- B. Sound lagging foil tape: 4" x 200' rolls of matching foil tape by Soundseal.
- C. Insulation for application over duct, piping & equipment.

PART 3 - EXECUTION

3.1 INSPECTION:

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.
- B. Workmanship shall be first class and of the highest quality, poor installation or bad appearance as determined by the engineer shall be due cause to reject the entire project in whole and retainage will be withheld until corrective action is completed to the engineer's satisfaction.

Edit Note: Coordinate extent and type of underground piping and insulation with drawings and Owner. CRA preferred method is pre-insulated piping systems

3.2 PLUMBING PIPING SYSTEM INSULATION:

- A. Insulation Omitted: Omit insulation on chrome-plated exposed piping (except for handicapped fixtures), air chambers, unions, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, fire protection piping, and pre-insulated equipment.

B. Cold Piping:

1. Application Requirements: Insulate the following cold plumbing piping systems:
 - a. Potable and non-potable cold water piping.
 - b. Potable chilled water piping.
 - c. Interior above-ground horizontal storm water piping including elbow up & down.
 - d. Roof drain bowls and roof drain leader to horizontal piping.
 - e. Overflow roof drain bowls and first 10 feet of overflow piping.
2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Above Ground Inside Building Fiberglass; ½ inch thickness.

C. Hot Piping:

1. Application Requirements: Insulate the following hot plumbing piping systems:
 - a. Potable hot water and tempered piping.
 - b. Potable hot water and tempered recirculating piping.
2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Fiberglass; 1/2 inch for runouts to individual fixtures 12'-0" or less in length, 1 inch thick for pipe sizes up to and including 2 inch, 1-1/2 inch thick for pipe sizes over 2 inches.
 - b. Below Ground Runouts to Individual Fixtures - Flexible Elastomeric: 1/2 inch thickness for pipe sizes up to 2 inches.
 - c. Sound Insulation: Insulate as shown on drawings. Provide 2 inch flexible fiberglass/vinyl sound insulation. Install with foil tape at all seams. Provide plastic wire ties every 18 inches around piping to fully fasten insulation to piping. Obtain a copy of manufacturer's installation requirements, keep copy on site, and follow all instructions.

3.3 HVAC PIPING SYSTEM INSULATION:

- A. Insulation Omitted: Omit insulation on steam condensate piping between steam trap and union; and on hot piping unions, flexible connections, and expansion joints. Insulation may be omitted inside of cabinet unit heaters, convectors and fan coils for hot piping. Cold piping insulation inside fan coil unit cabinet may be omitted provided piping is located over drain pan. Hot and cold piping routed inside air handler units shall be insulated. Omit insulation on strainers in heating water strainers operating below 200 degrees F.

Edit Note: The general industry standard is fiberglass. Cellular glass is a specialty product, but is superior in moisture resistance, and should be considered in exterior, underground, or high humidity applications. Verify local installers are familiar with the product, and any cost implications.

B. Heat Traced Piping:

1. Application Requirements: Insulate the following sub- zero HVAC piping systems:

- a. Piping exposed to freezing which is specified with heat cable.
 - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Fiberglass: 1-1/2 inch thick for pipe sizes up to and including 2 inch, 2 inch thick for pipe sizes over 2 inches.
 - b. Above Ground, Exterior - Cellular Glass: 1-1/2 inches thick for pipe sizes up to and including 2 inch, 2 inches thick for pipe sizes over 2 inches.
- C. Sub-Freezing Piping (0 to 39 deg. F (-18 to 4 degrees C)):
- 1. Application Requirements: Insulate the following sub-freezing HVAC piping systems:
 - a. Refrigerant suction lines between evaporators and compressors.
 - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Fiberglass: 2 inches thick for pipe sizes up to and including 1 inch, 2-1/2 inch thick for pipe sizes over 1 inch.
 - b. Above Ground Exterior - Cellular Glass: 1-1/2 inch thick for pipe sizes up to and including 1 inch, 2 inch thick for pipe sizes over 1 inch.
 - c. Pre-Insulated Soft Copper Refrigerant Line Sets - Flexible Elastomeric: 1 inch thickness for pipe sizes up to and including 2 inches.
- D. Cold Piping (40 degrees F (4.4 degrees C) to ambient):
- 1. Application Requirements: Insulate the following cold HVAC piping systems:
 - a. Chilled water supply and return piping.
 - b. Cold condensate drain piping.
 - c. Condenser water supply and return piping when used with plate and frame or cooling coil applications.
 - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
 - a. Fiberglass: 1/2 inch thick for runouts to individual units up to 2 inches in size and less than 12 feet-0 inches in length, 1 inch thick for pipe sizes up to and including 8 inch, 1-1/2 inch thick for pipe sizes over 8 inches.
 - b. Exterior, Above Ground - Cellular Glass: 1/2 inch thick for runouts to individual units up to 2 inches in size and less than 12 foot-0 inches in length, 1 inch thick for pipe sizes up to and including 2 inch, 2 inch thick for pipe sizes over 2 inches.
 - c. Below Ground - Flexible Elastomeric: 1/2 inch thickness for pipe sizes up to 2 inches.
- E. Dual Temperature Piping (40 degrees to 200 degrees F (5 to 90 degrees C)):
- 1. Application Requirements: Insulate the following dual temperature HVAC piping systems:

- 1) Hot and chilled water changeover supply and return piping.
 2. Insulate each piping system specified above with the heating system types and thicknesses of insulation specified for heating system piping, and with the methods required for cold piping.
- F. Heating System Piping (to 200 degrees F (90 degrees C)):
1. Application Requirements: Insulate the following heating piping systems:
 - a. Hot water supply and return piping.
 - b. Hot gas refrigerant piping (interior, exposed, less than 7feet-6inches above floor).
 - c. Hot gas bypass refrigerant piping (interior, exposed, less than 7feet-6inches above floor).
 - d. Low pressure steam vent & relief piping.
 - e. Heat recovery water.
 - f. Heat reclaim coil header.
 - g. Boiler feedwater piping.
 - h. Blowdown piping.
 2. Insulate each piping system specified above with the following type and thicknesses of insulation:
 - a. Fiberglass: ½ inch thick for runouts to individual units up to 2 inches in size and less than 12 feet-0 inches in length, 1-1/2 inches thick for pipe sizes up to and including 8 inch, 2 inch thick for pipe over 8 inches.
 - b. Above Ground Exterior - Cellular Glass: 2 inches thick for pipe sizes up to and including 8 inches, 2-1/2 inch thick for pipe sizes 8".
 - c. Underground Piping to Individual Terminal Units - Flexible Elastomeric: ½ inch thick up to 2 inch pipe size.
- G. High Temperature, Low Pressure Piping (200 to 250 degrees F (90 to 120 degrees C)):
1. Application Requirements: Insulate the following hot low pressure HVAC piping.
 - a. HVAC high temperature (200 to 250 degrees) hot water supply and return piping.
 - b. Low pressure steam (up to 15 psig).
 - c. Steam condensate piping (all pressures).
 2. Insulate each piping system specified above with the following type and thicknesses of insulation:
 - a. Fiberglass: 1 inch thick for runouts to individual units up to 2 inches in size and less than 12feet-0 inches in length. 1-1/2 inch thick for pipe sizes up to and including 2 inch, 2 inch thick for pipe sizes 2-1/2 inches through 4 inches, 3-1/2 inches thick for pipe sizes over 4 inches.
 - b. Above Ground, Exterior - Cellular Glass: 2-1/2 inches thick for pipe sizes up to and including 2 inch, 3 inch thick for pipe size 2-1/2 inches through 6 inches, and 5 inches thick for pipe sizes over 8 inches.
- H. High Temperature, Medium and High Pressure Piping (250 to 350 degrees F (120 to 175 degrees C)):

1. Application Requirements: Insulate the following hot high pressure HVAC piping:
 - a. High temperature (250 degrees to 350 degrees) hot water supply and return piping.
 - b. Medium and High pressure (16 to 125 psig) steam piping.

2. Insulate each piping system specified above with the following type and thicknesses of insulation:
 - a. Fiberglass: 2 inches thick for pipe sizes up to and including 1 inch, 2-1/2 inches thick for pipe sizes 1-1/4 inch through 4 inches, and 3-1/2 inches thick for pipe sizes over 4 inches.
 - b. Exterior, Above Ground - Cellular Glass: 3 inches thick for pipe sizes up to and including 1 inch, 4 inches thick for pipe size 1-1/4 inch through 4 inches, and 5 inches thick for pipe sizes over 4 inches.

- I. High Temperature Piping (to 1200 degrees F (649 degrees C):
 1. Application Requirements: Insulate the following hot high temperature piping:
 - a. Exhaust Piping fittings and silencers for emergency generators.
 - b. Exhaust Piping fittings and silencers for engine driven fire pumps.
 2. Insulate each piping system specified above with the following type and thicknesses of insulation:
 - a. Calcium Silicate: 4 inches thick.
 - b. Fiberglass is not acceptable.

- J. High Temperature Piping (to 2000 degrees F (1093 degrees C)):
 1. Application Requirements: Insulate the following hot high temperature piping:
 - a. Exhaust Piping fittings and silencers for emergency generators.
 - b. Exhaust Piping fittings and silencers for engine driven fire pumps.
 2. Insulate each piping system specified above with the following type and density of insulation:
 - a. (Concealed Piping) Flexible thermal Ceramic: 6 pcf
 - b. (Exposed Piping) Rigid Thermal Ceramic System.

Edit Note: Thickness dependent on temperature and design of insulating system

- c. Provide thickness as required to maintain a outer surface temperature of _____ degrees F, with an ambient air temperature of _____ degrees F, and a fluid temperature of _____ degrees F.
- d. Calcium Silicate is not acceptable.

3.4 DUCTWORK SYSTEM INSULATION:

- A. Insulation Omitted: Do not insulate fibrous glass ductwork, or lined ductwork.
- B. Application Requirements: Insulate the following ductwork:
 1. Outdoor air intake ductwork and plenums between air entrance and fan inlet or HVAC unit inlet.
 2. Mixed air ductwork and plenums between air entrance and fan inlet or HVAC unit inlet.
 3. HVAC supply ductwork between fan discharge, or HVAC unit discharge, and room terminal outlet unless ductwork is specified to be lined.
 4. HVAC return ductwork in unconditioned spaces or exterior; except omit insulation when ductwork is specified to be lined.
 5. HVAC plenums and unit housings not pre-insulated at factory or lined.
 6. Rigid oval or round supply air ductwork.
- C. Insulate each ductwork system specified above with the following types and thicknesses of insulation:

APPLICATION	TYPE, THICKNESS		
	RIGID/ FIBERGLASS (see notes 1&2)	FLEXIBLE FIBERGLASS	FLEXIBLE ELASTOMERIC**
Interior; concealed; cold, hot or dual temperature duct	1" min. up to 2" as required to cover joints & reinforcements	1-1/2"	1"
[Engineer's Edit Note: In humid/humidified environments, the flanges must be covered to prevent condensation]			
Interior; exposed within conditioned finished spaces; cold, hot, or dual temperature duct	None 1" min. up to 2" as required to cover joints & reinforcements	None <u>Not Allowed</u> except for budget considerations	None 1" min. up to 2" as required to cover joints & reinforcements. Provide white finish coat.
[Engineer's Edit Note: Duct Mate Fittings require 2". Coordinate with ductwork specification.]			
Interior; exposed within mechanical, electrical, storage, or other service areas; cold, hot, or dual temperature duct	1" min. up to 2" as required to cover joints and reinforcements	Not Allowed except for budget considerations	1" min. up to 2" as required to cover joints and reinforcements with white finish. Provide white finish coat.
[Engineer's Edit Note: Duct Mate Fittings require 2". Coordinate with ductwork specification.]			

Exterior; hot or dual temperature duct, all return duct	Not Allowed	Not Allowed	2" with metal jacket OR with weather protective finish OR with rubber/Tedlar jacket
Unconditioned Attic; hot, cold, dual temperature, or return duct	1-1/2"	2"	1-1/2"
Unconditioned Crawl Space; cold duct, returns serving exclusively cooling systems	1"	1-1/2"	1"
Unconditioned Crawl Space; hot, dual temperature or return duct	1-1/2"	2"	1-1/2"
Edit Note #1: Use semi-rigid fiberglass insulation for round or flat oval duct			

3.5 EQUIPMENT INSULATION:

A. Cold Equipment (Below Ambient Temperature):

1. Application Requirements: Insulate the following cold equipment:

- a. Refrigeration equipment, including chillers, tanks and pumps, including any cold surfaces not factory insulated.
- b. Condensate pans under chilled equipment.
- c. Cold water storage tanks.
- d. Cold and chilled water pumps.
- e. Pneumatic water tanks.
- f. Air separators.

2. Insulate each item of equipment specified above with the following types and thicknesses of insulation:

- a. Rigid Fiberglass: 1 inch thick for surfaces above 35 degrees F (2 degrees C) and 1-1/2 inch thick for surfaces 35 degrees F (2 degrees C) and lower.
- b. Flexible Elastomeric Sheet: 3/4 inch thickness for surface temperatures above 35 degrees F (2 degrees C), 1 inch thickness for surface temperatures below 35 degrees F (2 degrees C).

B. Hot Equipment (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot equipment:

- a. Boilers (not pre-insulated at factory).
- b. Hot water storage tanks.
- c. Water heaters (not pre-insulated at factory)
- d. Heat exchangers.
- e. Condensate receivers.
- f. Hot water pumps operating over 200 degrees.

- g. Condensate pumps.
 - h. Flash tanks.
 - i. Air separators.
 - j. Blow down separators.
 - k. Induced draft fan scrolls.
 - l. Feedwater storage tanks.
 - m. Absorption chiller hot surfaces (not pre-insulated at factory)
2. Insulate each item of equipment specified above with the following types and thicknesses of insulation:
- a. Fiberglass: 2 inch thick, except 3 inch thick for low- pressure boilers and steam-jacketed heat exchangers. Do not use for equipment above 450 degrees F (232 degrees C).
 - b. Calcium Silicate: 3 inch thick, except 4 inch thick for diesel exhaust mufflers and 4-1/2 inches thick for low-pressure boilers and steam-jacketed heat exchangers.
3. Application Requirements: Insulate the following breechings and stacks:
- a. Breechings between heating equipment outlet and stack or chimney connection, except for double wall or factory insulated breechings.
 - b. Stacks from bottom to top except for factory insulated stacks.
4. Insulate each breeching and stack specified above with the following types and thicknesses of insulation:
- a. Calcium Silicate: 4 inches thick (2 layers of 2 inch thickness).

3.6 INSTALLATION OF PIPING INSULATION:

- A. General: 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. Install insulation on pipe systems subsequent to installation of heat tracing, testing, and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor-barrier jackets on cold pipe insulation, and protect to prevent puncture or other damage.
 - 1. Do not use staples or tacks on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier finish recommended by the manufacturer.
 - 3. Seal fitting covers with PVC tape.

4. Cover all unions, check valves, and other in-line devices. Mark outer covering with indelible marker to identify item covered.
- F. Neatly bevel and seal insulation at all exposed edges.
 - G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
 - H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
 - I. See equipment insulation for removable insulation on accessible piping components.
 - J. See Section 15140 for insulation inserts and shields. Butt pipe insulation against pipe hanger insulation inserts. For all piping apply wet coat of vapor barrier lap cement on butt joints and seal all joints and seams with 3 inch wide vapor barrier tape or band.
 - K. Flexible Elastomeric Piping Insulation:
 1. Install unslit, by slipping over piping prior to joining, or install pre-insulated soft copper tubing.
 2. Seal butt ends with adhesive.
 - L. Cellular Glass Insulation:
 1. Apply in a single layer. Secure to pipe with ½ inch wide aluminum bands.
 2. For indoor applications, apply all purpose Kraft paper/aluminum foil/vinyl coating jacket. Seal all lap and butt joints with self seal vapor barrier tape.
 3. For outdoor applications, apply aluminum rubber/Tedlar jacketing as described below.
 - M. Calcium Silicate Insulation:
 1. Apply in a single layer. Secure to pipe with 1/2 inch wide aluminum bands.
 2. For indoor applications, provide canvas jacketing. Adhere joints of jacketing and provide a finish coat of sealant as recommended by the manufacturer.

<p>EDIT NOTE: Choose aluminum or rubber/Tedlar jacketing. Delete protective finish except for budget jobs.</p>
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- N. Piping Exposed to Weather: Protect outdoor insulation from weather by installing outdoor protective finish or aluminum rubber/Tedlar jacketing.
 1. Jacketing shall be secured by 1/2 inch wide stainless steel bands located on 24 inch centers. All joints and seams shall be caulked with clear silicone. Locate all longitudinal seams at the bottom of piping to minimize joint exposure to weather. Contractor may propose pre-fabricated sealing and fastening systems, submit samples and product data for approval.
 2. On flexible elastomeric pipe insulation apply two (2) coats of manufacturer's approved U.V. resistant finish.

3.7 INSTALLATION OF DUCTWORK INSULATION:

- A. General: 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. Install insulation materials with smooth and even surfaces.
- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.
 - 1. Avoid the use of staples on vapor barrier jackets.
 - 2. Seal vapor barrier penetrations with vapor barrier tape recommended by the manufacturer.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- G. Flexible Fiberglass Insulation: Cut back insulation to provide a 2 inch facing overlap at all seams. Seams shall be stapled approximately 6 inches on center with outward clinching staples, then sealed with pressure-sensitive tape matching the facing and designed for use with duct insulation. The underside of ductwork 24 inches or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18 inches on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then sealed with the same tape as specified above.
- H. Corner Angles: Except for oven and hood exhaust duct insulation, install corner angles on all external corners of insulation on ductwork in exposed finished spaces before covering with jacketing.
- I. Adhere flexible elastomeric sheets to clean oil-free metal surface by compression fit method and full coverage of adhesive. Seal butt joints with same adhesive. For exterior ductwork, notch insulation at reinforcements and joint flanges to provide a smooth surface, unless the reinforcements or joints would penetrate the insulation. Provide a minimum ½ inch cap over any penetrating item. Stagger all joints and seams on multi-layer insulation.

3.8 INSTALLATION OF EQUIPMENT INSULATION:

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose. Complete finishes as specified.
- 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 gaping 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, mufflers, breechings, or stacks while hot.

- E. Apply insulation using staggered joint method and double layer construction. Apply each layer of insulation separately.
- F. Insulation board shall be cut and mitered to fit the contour of the vessel and shall be applied with edges tightly butted, joints staggered where two or more layers are necessary (due to available thickness of insulation) and secured with 1/2 inch x 0.015inch galvanized steel bands on 12 inch centers or with weld pins or stick clips with washers on 18inch centers.

Coat insulated surfaces with layer of insulating cement, cover the insulation, 1 inch galvanized wire mesh shall be tightly stretched in place with edges tied together and finished between two coats of insulating cement troweled to a hard finish (not less than 1/4 inch thick).

OR

Troweled in workmanlike manner, leaving smooth continuous surface. Fill in scored block, seams, chipped edges and depressions and to remove surface irregularities.

OR

Cover insulated surfaces with all-service jacketing neatly fitted and firmly secured. Lap seams at least 2". Apply over vapor barrier where applicable.

- G. Do not insulate hot equipment ASME stamp and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- H. Cold equipment requiring access: Provide removable section of insulation, fabricated from flexible elastomeric insulation, adhered to an aluminum jacket, and joined with velcro strips around entire perimeter. Reinforce removable section and adjoining insulation at attachment points. Removable insulation shall be provided for all equipment requiring periodic inspection, access or maintenance including:
 1. Chilled water pump bodies.
 2. Strainer basket access.
 3. Heat exchanger (including chillers) tube access.
 4. Handhold/cleanout covers.
- I. Hot equipment requiring access: Provide removable section of insulation, fabricated from rigid fiberglass insulation board, adhered to an aluminum jacket, and fastened to the equipment with stainless steel bands. At Contractor's option, provide pre-fabricated, canvas jacketed, lace-up insulation blankets.

Provide removable insulation for hot equipment requiring access with accessible components over 100 square inches or any component operating over 200 degrees including:

 1. Steam condensate receivers and pumps.
 2. Steam Strainers.
 3. Steam pressure regulators.
 4. Heat exchanger tube access.
 5. Handhole/manhole/cleanout access.
- J. Equipment Exposed to Weather: Protect outdoor insulation from weather by installation of aluminum jacketing, as recommended by manufacturer. On flexible elastomeric insulation, apply two (2) coats of manufacturer's approved U.V. resistant finish.

3.9 EXISTING INSULATION REPAIR:

- A. Repair damaged sections of existing mechanical insulation, both previously damaged or damaged during this construction period. Use insulation, install new jacket lapping and sealed over existing.

3.10 PROTECTION AND REPLACEMENT:

- A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 15250