

SECTION 15080  
MECHANICAL INSULATION

PART 1 - GENERAL

1.01 PROVISIONS INCLUDED

- A. The general provisions of the Contract, including General and Supplementary General Conditions, and Division 1 General Requirements, apply to work specified in this Section.
- B. Requirements of Section 15050, "Basic Mechanical Materials and Methods" apply to this Section.

1.02 SUMMARY

- A. Provide pipe, duct and equipment insulation throughout as indicated by drawings, schedules, and the requirements of this section including:
  - 1. Ductwork insulation, jackets, and lining.
  - 2. Equipment insulation, and covering.
  - 3. Piping insulation, jackets and accessories.

1.03 DEFINITIONS

- A. Hot Surfaces: Normal operating temperatures of 100°F or higher.
- B. Dual-Temperature Surfaces: Normal operating temperatures that vary from hot to cold.
- C. Cold Surfaces: Normal operating temperatures less than 75°F.
- D. Thermal Resistivity: "r-values" represent the reciprocal of thermal conductivity (k-value). Thermal conductivity is the rate of heat flow through a homogenous material exactly 1 inch thick. Thermal resistivities are expressed by the temperature difference in degrees F between two exposed faces required to cause one Btu to flow through one square foot of material, in one hour, at a given mean temperature.
- E. Density: Is expressed in lb/sq.ft.

1.04 SUBMITTALS

- A. Product data for each type of mechanical insulation identifying k-value, thickness, and accessories.

1.05 QUALITY ASSURANCE

- A. Fire Performance Characteristics: Conform to the following characteristics for insulation including facings, cements, and adhesives, when tested according to ASTM E 84, by UL or other testing or inspecting organization acceptable to the authority having jurisdiction. Label insulation with appropriate markings of testing laboratory.

1. Interior Insulation: Flame spread rating of 25 or less and a smoke developed rating of 50 or less.
2. Exterior Insulation: Flame spread rating of 75 or less and a smoke developed rating of 150 or less.

#### 1.06 SEQUENCING AND SCHEDULING

- A. Schedule insulation application after testing of piping and duct systems.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:
  1. Glass Fiber:
    - a. CertainTeed Corporation.
    - b. Knauf.
    - c. Schuller (Manville).
    - d. Owens-Corning Fiberglas Corporation.
    - e. USG Interiors, Inc. - Thermafiber Division.
  2. Cellular Glass:
    - a. Pittsburgh Corning Corporation or equal.
  3. Flexible Elastomeric Cellular:
    - a. Armstrong World Industries, Inc.
    - b. Halstead Industrial Products.
    - c. IMCOA.
    - d. Rubatex Corporation.

#### 2.02 PIPE INSULATION

- A. Glass Fiber: Schuller Micro-Lok meeting ASTM C547; rigid molded, noncombustible.
  1. 'K' ('ksi') Value : 0.23 at 75 degrees F (0.033 at 24 degrees C).
  2. Maximum Service Temperature: 850 degrees F (454 degrees C).
  3. Vapor Retarder Jacket: AP-T PLUS White kraft paper reinforced with glass fiber yarn and bonded to aluminum foil, secure with self sealing longitudinal laps and butt strips or AP Jacket with outward clinch expanding staples or vapor barrier mastic as needed.
- B. Elastomeric Foam: Rubatex R-180-FS/R-1800-FS meeting ASTM C534; flexible, cellular elastomeric, molded or sheet.
  1. 'K' ('ksi') Value:0.28 at 75 degrees F ( 0.04 at 24 degrees C).
  2. Maximum Service Temperature of 220 degrees F (104 degrees C).
  3. Maximum Flame Spread: 25.
  4. Maximum Smoke Developed: 50 (3/4" thick and below); 100 (above 3/4" thick).
  5. Connection: Waterproof vapor retarder adhesive as needed; Rubatex R-373 Adhesive.
  6. UV-Protection: Outdoor protective coating; Rubatex 374 Coating.

- C. Cellular Glass: ASTM C522; 'k' value of 0.35 at 75 degrees F ('ksi' value of 0.047 at 24 degrees C); 8.0 lb/cu ft (128 Kg/cu m) density.
- D Field Applied Jackets
  - 1. PVC Plastic: Schuller Zeston 2000. One piece molded type fitting covers and jacketing material, gloss white.
    - a. Connections: Tacks; Pressure sensitive color matching vinyl tape.

## 2.03 EQUIPMENT INSULATION

- A. Flexible Fiber Glass Blanket: Schuller 812 Spin-Glas meeting ASTM C612; flexible.
  - 1. 'K' ('ksi') Value : 0.24 at 75 degrees F (0.035 at 24 degrees C).
  - 2. Maximum Service Temperature: 450 degrees F (232 degrees C).
  - 3. Density: 1.5 lb/cu ft (24 kg/cu m) density.
  - 4. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinch expanding staples and vapor barrier mastic as needed.
- B. Rigid Fiber Glass Board: Schuller 814 Spin-Glas meeting ASTM C612; rigid.
  - 1. 'K' ('ksi') Value : 0.23 at 75 degrees F (0.033 at 24 degrees C).
  - 2. Maximum Service Temperature: 450 degrees F (232 degrees C).
  - 3. Density: 3.0 lb/cu ft (48 kg/cu m) density.
  - 4. Vapor Retarder Jacket: Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinch expanding staples and vapor barrier mastic as needed.
  - 5. Facing: 1 inch (25 mm) galvanized hexagonal wire mesh stitched on one face of insulation. (optional)
- C. Rigid Fiber Glass Board: Schuller 1000 Spin-Glas meeting ASTM C612; rigid, noncombustible.
  - 1. 'K' ('ksi') Value: 0.23 at 75 degrees F (0.033 at 24 degrees C)
  - 2. Maximum Service Temperature: 850 degrees F (454 degrees C)
  - 3. Density: 3.0 lb/cu ft (48 kg/cu m)
  - 4. Facing: 1 inch (25mm) galvanized hexagonal wire mesh stitched on one face of insulation.

## 2.04 DUCTWORK INSULATION

- A. Flexible Fiber Glass Blanket: Schuller Microlite Type 75 meeting ASTM C553, Type 1, Class B-2; flexible blanket.
  - 1. 'K' ('ksi') Value : 0.27 at 75 degrees F (0.040 at 24 degrees C) installed.
  - 2. Density: .75 lb/cu ft (12 kg/cu m).
  - 3. Vapor Barrier Jacket: FSK, Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.
- B. Rigid Fiber Glass Board: Schuller 814 Spin-Glas meeting ASTM C612; rigid board.
  - 1. 'K' ('ksi') Value: 0.23 at 75 degrees F (0.033 at 24 degrees C).
  - 2. Density: 3.0 lb/cu ft (48 kg/cu m).

3. Vapor Retardant Jacket: AP, bleached kraft paper bonded to aluminum foil, reinforced with fiber glass yarn; or FSK, Aluminum foil reinforced with fiber glass yarn and laminated to fire-resistant kraft, secured with UL listed pressure sensitive tape and/or outward clinched expanded staples and vapor barrier mastic as needed.

## 2.05 INSULATING CEMENTS

- A. Mineral Fiber: ASTM C 195.
  1. Thermal Conductivity: 1.0 average maximum at 500 deg F mean temperature.
  2. Compressive Strength: 10 psi at 5 percent deformation.
- B. Expanded or Exfoliated Vermiculite: ASTM C 196.
  1. Thermal Conductivity: 1.10 average maximum at 500 deg F mean temperature.
  2. Compressive Strength: 5 psi at 5 percent deformation.
- C. Mineral Fiber, Hydraulic-Setting Insulating and Finishing Cement: ASTM C 449.
  1. Thermal Conductivity: 1.2 average maximum at 400 deg F mean temperature.
  2. Compressive Strength: 100 psi at 5 percent deformation.

## 2.06 ADHESIVES

- A. Flexible Elastomeric Cellular Insulation Adhesive: Solvent-based, contact adhesive recommended by insulation manufacturer.
- B. Lagging Adhesive: MIL-A-3316C, non-flammable adhesive in the following Classes and Grades:
  1. Class 1, Grade A for bonding glass cloth and tape to unfaced glass fiber insulation, sealing edges of glass fiber insulation, and bonding lagging cloth to unfaced glass fiber insulation.
  2. Class 2, Grade A for bonding glass fiber insulation to metal surfaces.

## 2.07 JACKETS

- A. General: ASTM C 921, Type 1, except as otherwise indicated.
- B. Foil and Paper Jacket: Laminated glass-fiber-reinforced, flame-retardant kraft paper and aluminum foil.
  1. Water Vapor Permeance: 0.02 perm maximum, when tested according to ASTM E 96.
  2. Puncture Resistance: 50 beach units minimum, when tested according to ASTM D 781.
- C. PVC Jacketing: High-impact, ultra-violet-resistant PVC, 20-mils thick, roll stock ready for shop or field cutting and forming to indicated sizes.
  1. Adhesive: As recommended by insulation manufacturer.
- D. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high-impact, ultra-violet-resistant PVC.
  1. Adhesive: As recommended by insulation manufacturer.

- E. Aluminum Jacket: ASTM B 209, 3003 Alloy, H-14 temper, factory cut and rolled to indicated sizes.
  - 1. Finish and Thickness: Stucco embossed finish, 0.016 inch thick.
  - 2. Moisture Barrier: 3-mil Dupont Surlyn.
  - 3. Elbows: Preformed 45-degree and 90-degree, short- and long-radius elbows, same material, finish, and thickness as jacket.

## 2.08 ACCESSORIES AND ATTACHMENTS

- A. Glass Cloth and Tape: Woven glass fiber fabrics, plain weave, presized a minimum of 8 ounces per sq. yd.
  - 1. Tape Width: 4 inches.
  - 2. Cloth Standard: MIL-C-20079H, Type I.
  - 3. Tape Standard: MIL-C-20079H, Type II.
- B. Bands: 3/4-inch wide, in one of the following materials compatible with jacket:
  - 1. Stainless Steel: Type 304, 0.020 inch thick.
  - 2. Galvanized Steel: 0.005 inch thick.
  - 3. Aluminum: 0.007 inch thick.
  - 4. Brass: 0.01 inch thick.
  - 5. Nickel-Copper Alloy: 0.005 inch thick.
- C. Wire: 14-gage nickel copper alloy, 16-gage, soft-annealed stainless steel, or 16-gage, soft-annealed galvanized steel.
- D. Corner Angles: 28-gage, 1-inch by 1-inch aluminum, adhered to 2-inch by 2-inch kraft paper.
- E. Anchor Pins: Capable of supporting 20 pounds each. Provide anchor pins and speed washers of sizes and diameters as recommended by the manufacturer for insulation type and thickness.

## 2.09 SEALING COMPOUNDS

- A. Vapor Barrier Compound: Water-based, fire-resistive composition.
  - 1. Water Vapor Permeance: 0.08 perm maximum.
  - 2. Temperature Range: Minus 20 to 180 deg F.
- B. Weatherproof Sealant: Flexible-elastomer-based, vapor-barrier sealant designed to seal metal joints.
  - 1. Water Vapor Permeance: 0.02 perm maximum.
  - 2. Temperature Range: Minus 50 to 250 deg F.
  - 3. Color: Aluminum.

## PART 3 - EXECUTION

### 3.01 EXAMINATION AND PREPARATION

- A. Verify that ductwork and piping has been tested for leakage in accordance with SMACNA standards before applying insulation materials.

- B. Verify that all surfaces are clean, dry and free of foreign material.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.

- B. Continue insulation vapor barrier through penetrations except where prohibited by code.

- C. Piping Insulation

1. Locate insulation and cover seams in least visible locations.
2. Neatly finish insulation at supports, protrusions, and interruptions.
3. Provide insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature with vapor retardant jackets with self sealing laps. Insulate complete system.
4. For insulated pipes conveying fluids above ambient temperature, secure jackets with self sealing lap or outward clinched, expanded staples. Bevel and seal ends of insulation at equipment, flanges, and unions.
5. Provide insert between support shield and piping on piping 1 1/2" inches (38 mm) diameter or larger. Fabricate of Schuller Thermo-12 or other heavy density insulating material suitable for temperature. Insulation inserts shall not be less than the following lengths:

1 1/2" to 2 1/2" pipe size	10" long
3" to 6" pipe size	12" long
8" to 10" pipe size	16" long
12" and over	22" long

6. Provide one piece molded fitting covers and jacketing for all insulated fittings.
7. For all pipe, fittings and associated hydraulic specialty equipment (air separators, valves, and pumps) exposed in mechanical equipment rooms to be finish with Schuller Zeston 2000 PVC jacket and fitting covers, colors as follows:
  1. Chilled water - Blue
  2. Energy Recovery - Green
  3. Hot water - Yellow
  4. Steam & Condensate Red
  5. Cold water - Purple
  6. Drain lines Brown
8. For exterior applications, provide weather protection jacket. Insulated pipe, fittings, joints, and valves shall be covered with aluminum jacket. Jacket seams shall located on bottom side of horizontal piping.
9. Equipment Insulation:

- a. Apply insulation as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. As required, secure insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- b. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retardant cement.
- c. Provide insulated dual temperature equipment or cold equipment containing fluids below ambient temperature with vapor retardant jackets.
- d. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.
- e. Cover insulation with metal mesh and finish with heavy coat of insulating cement, mastic, or aluminum jacket as indicated in the drawings.
- f. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- g. When equipment with insulation requires periodic opening for maintenance, repair, or cleaning, install insulation in such a manner that it can be easily removed and replaced without damage.

D. External Ductwork Insulation:

1. Provide insulated ductwork conveying air below ambient temperature with vapor retardant jacket. Seal all vapor retardant jacket seams and penetrations with UL listed tapes or vapor retardant adhesive.
2. Provide insulated ductwork conveying air above ambient temperature with or without vapor retardant jacket. Where service access is required, bevel and seal ends of insulation.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations except where prohibited by code.
4. The underside of duct work 24" or greater shall be secured with mechanical fasteners and speed clips spaced approximately 18" on center. The protruding ends of the fasteners should be cut off flush after the speed clips are installed, and then, when required, sealed with the same tape as specified above.
5. For insulated ductwork exposed to physical abuse in mechanical equipment rooms below 10 feet above finished floor, finish with Schuller Zeston 2000 PVC jacket or aluminum jacket.

3.03 PIPING INSULATION SCHEDULE

**Table 1**

	Application	Temperature Range	Maximum Diameter	Outside Building	Inside Building
A.	Chilled Water S&R	44°F - 56°F	10 in.	FG,MJ	FG,ASJ
B.	Domestic Hot Water	105°F - 170°F	4 in.	N/A	FG,ASJ
C.	Process Piping	44°F - 60°F	12 in.	N/A	FG,ASJ
D.	Domestic Cold and	35°F - 60°F	4 in.	N/A	FG,ASJ

	Non-Potable Water				
E.	Steam and Condensate	212°F	8 in.	FG,MJ	FG,ASJ
F.	Energy Recovery Water	100°F - 85°F	8 in.	FG,MJ	FG,ASJ
G.	Heating Hot Water	200°F - 140°F	6 in.	N/A	FG,ASJ
H.	Drain Lines	40°F - 95°F	2 in	FG, MJ	FG,ASJ
I.	Interior Condensate Drain Lines	32°F - 55°F	4 in		FG,ASJ

Legend:

FG: Fiberglass                      ASJ: All Service Jacket  
EF: Elastomeric Foam            MJ: Metal Jacket

**Table 2 - Minimum Thickness Glass Fiber Insulation**

Application	Diameter	Outside Building, In.	Interior In.
A. Chilled water S&R 44°F – 56°F	Run-outs to 2"	1-1/2	1
	2" and smaller	1-1/2	1
	2-1/4" thru 6"	2	1-1/2
	6" to 16" (max)	2	2
B. Domestic hot water 105°F - 170°F	Run-outs to 1"	N/A	1
	1" and smaller	N/A	1
	1-1/4" to 2"	N/A	1
	2-1/2" to 4" (max)	N/A	1-1/2
C. Process Piping 44°F – 60°F	Run-outs to 2"	N/A	1
	2" and smaller	N/A	1
	2-1/4" to 6"	N/A	1-1/2
	6" to 16" (max)	N/A	2
D. Domestic cold water & Non-Potable water 35°F – 60°F	Run-outs to 1-1/4"	N/A	1
	2" and smaller	2"N/A	1
	2-1/4" to 6"	N/A	1
	6" to 16" (max)		1-1/2
E. Energy Recovery water supply and return	All sizes	2"	1-1/2"
F. Heating Hot water 200°F - 140°F	Run-outs to 1-1/2"	N/A	1-1/2
	2" and smaller	N/A	1-1/2
	2-1/2" to 6" (max)	N/A	2
G. Steam and Condensate	Runouts to 1-1/4"	1-1/2"	1-1/2"
	1-1/2 to 4"	2"	2"
	5"-10"	3"	3"
H. Condensate Lines	½ to 1-1/2"	1-1/2	1-1/2
	2" and smaller	1-1/2	1-1/2
	2-1/2" to 4" (max)	2	2



3.04 EQUIPMENT INSULATION SCHEDULE

		Thickness Inch (mm)
A.	Flexible Fiber Glass Blanket	
	Water Softeners	1
	Heat Exchangers/Converters (Excluding Process Cooling Water Heat Exchanger)	1-1/2
	Air Separators	1
	Chilled Water Pump Bodies	1-1/2
B.	Rigid Fiber Glass Board	
	Domestic Hot Water Storage Tanks	2
C.	Elastomeric Foam	
	Chiller Cold Surfaces (not factory insulated)	1-1/2

3.05 DUCTWORK INSULATION SCHEDULE

		THICKNESS Inch (mm)	FINISH
A.	Flexible Fiber Glass		
	Exhaust Ducts Within 10 ft (3 m) of Exterior Openings	1-1/2	FSK
	Exhaust Ducts associated with fume exhaust heat recovery unit	1-1/2	FSK, Note #1
	Supply Ducts (Cooling and Heating Systems)	1-1/2	FSK
	Return Ducts in Unconditioned Spaces	1-1/2	FSK
B.	Rigid Fiber Glass		
	Outside Air Intake Ducts	2	FSK
	Plenums (Cooling and Heating Systems)	2	FSK
	Return and Relief Ducts in Mechanical Rooms	1-1/2	FSK

Note: 1. On exterior ductwork provide rubber roofing membrane as protective jacket refer to detail on contract drawings. Conform to specification 07531.

END OF SECTION 15080