PIPING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. This Section includes preformed, rigid and flexible pipe insulation; field-applied jackets; accessories and attachments; and sealing compounds.

1.2 SUBMITTALS

A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied,if any), for each type of product indicated.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training, such as the Apprentice Program established by Local 16 Heat and Frost Insulators.

B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency – UL listed, conform to NFPA 90A.

1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.4 COORDINATION

A. Coordinate clearance requirements with piping Installer for insulation application.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Mineral-Fiber Insulation:
    a. Owens Corning Fiberglas Pipe Insulation
    b. Knauf Fiberglass GmbH.
    c. Johns Manville
    d. Manson Insulation
2. Flexible Elastomeric Thermal Insulation:
    a. Aerocell U.S.A., Inc.

b. Armacell

c. K-Flex USA

3. Cellular Glass Insulation

a. Owens Corning

2.2 INSULATION MATERIALS

A. Mineral-Fiber Insulation: Glass fibers bonded with a thermosetting resin complying with the following:

1. Preformed Pipe Insulation: Comply with ASTM C 547, Type 1, with factory-applied, all- purpose, vapor-retarder jacket.
2. Blanket Insulation: Comply with ASTM C 553, Type II, without facing.
3. Fire-Resistant Adhesive: Comply with MIL-A-3316C in the following classes and grades:
   a. Class 1, Grade A for bonding glass cloth and tape to unfaced glass-fiber insulation, for sealing edges of glass-fiber insulation, and for bonding lagging cloth to unfaced glass-fiber insulation.
   b. Class 2, Grade A for bonding glass-fiber insulation to metal surfaces.
4. Vapor-Retarder Mastics: Fire- and water-resistant, vapor-retarder mastic for indoor applications. Comply with MIL-C-19565C, Type II.
5. Mineral-Fiber Insulating Cements: Comply with ASTM C 195.
6. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

B. Cellular-Glass Insulation: Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.

1. Preformed Pipe Insulation, without Jacket: Comply with ASTM C 552, Type II, Class 1.
2. Preformed Pipe Insulation, with Jacket: Comply with ASTM C 552, Type II, Class 2.

C. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.

1. Adhesive: As recommended by insulation material manufacturer.
2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

D. Calcium Silicate Insulation: Preformed high temperature, abuse resistant, pipe and block insulation.

1. For use on systems operating up to 1200 degrees F
2. Inorganic, non-combustible
3. Asbestos Free
4. Complies with ASTM C533

E. Prefabricated Thermal Insulating Fitting Covers: Comply with ASTM C 450 for dimensions used in performing insulation to cover valves, elbows, tees, and flanges.

2.3 FIELD-APPLIED JACKETS

A. General: ASTM C 921, Type 1, unless otherwise indicated.

B. PVC Jacket: High-impact, ultraviolet-resistant PVC; 20 mils thick; roll stock ready for shop or field cutting and forming.

1. Adhesive: As recommended by insulation material manufacturer.
2. PVC Jacket Color: White or gray.

C. PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil-thick, high- impact, ultraviolet-resistant PVC. 30-mil-thick can be provided if required in high abuse areas.

1. Shapes: Welded and Victaulic 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers forlavatories for the disabled.
2. Adhesive: As recommended by insulation material manufacturer.

D. Aluminum Jacket:

1. Factory cut and rolled to indicated sizes. Comply with ASTM B 209, 3003 alloy, H-14 temper, 0.016 inch thick.

E. Aluminum Fitting Covers

1. Shapes: Welded 45 and 90 degree, short and long-radius elbows, and end caps

2.4 ACCESSORIES AND ATTACHMENTS

A. Tapes

1. ASJ Tape Width: 3 inches.

B. Bands: One of the following materials compatible with jacket:

1. Stainless Steel: ASTM A 666, Type 304; 0.020 inch thick. ½" or ¾" wide
2. Aluminum: 0.020 inch thick. ASTM B-209. ½" or ¾" wide

C. Wire: 0.080-inch (2.0-mm), nickel-copper alloy; 0.062-inch, soft-annealed, stainless steel.

D. Screws: Self Taping

2.5 VAPOR RETARDERS

A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry pipe and fitting surfaces.

3.2 GENERAL APPLICATION REQUIREMENTS

A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.

B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.

C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Apply insulation with longitudinal seams at top of horizontal pipe runs.

E. Apply multiple layers of insulation with longitudinal and end seams staggered.

F. On insulated systems requiring a vapor barrier, seal joints and seams with vapor-retarder mastic or Vapor barrier Tape.

G. Keep insulation materials dry during application and finishing.

H. Apply insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive when recommended by the insulation material manufacturer.

I. Apply insulation with the least number of joints practical.

J. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.

K. Hangers and Anchors: Where vapor retarder is indicated, seal penetrations in insulation at hangers, supports, anchors, and other projections with vapor-retarder mastic or tape.

1. Apply insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor retarders are indicated, extend insulation on anchor legs at least 2 pipe diameters from point of attachment to pipe and taper insulation ends. Seal tapered ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.
3. At pipe support insulation inserts, butt adjoining pipe insulation tight to the insert and seal joint with tape, adhesive or sealing compound recommended by the insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation.

L. Insulation Terminations: For insulation application where vapor retarders are indicated, seal the ends with a compound recommended by the insulation material manufacturer to maintain vapor retarder.

M. Apply adhesives and mastics at the manufacturer's recommended coverage rate.

N. Apply insulation with integral jackets as follows:

1. Pull jacket tight and smooth.
2. Circumferential Joints: Cover with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples at overlapped seam.
3. Longitudinal Seams: Overlap jacket seams at least 1 inch. Apply insulation with longitudinal seams away from traffic in exposed locations. Clean and dry surface to receive self-sealing lap. If required staple laps with outward clinching staples along edge at 6 inches on center.
    a. Exception: Do not staple longitudinal laps on insulation having a vapor retarder.
4. Vapor-Retarder Mastics: Where vapor retarders are indicated, apply mastic or tape on seams and joints and at ends adjacent to flanges, unions, valves, and fittings.
5. At penetrations in jackets for thermometers and pressure gages, fill and seal voids with vapor-retarder mastic or tape.

O. Roof Penetrations: Apply insulation for interior applications to a point even with top of roof flashing.

1. Storm Collar to be sealed directly to pipe surface with no insulation extending through the roof collar opening.
2. Insulation will be butted up to the sealed roof penetration from below.
3. On systems requiring a vapor barrier, mastic will be applied to the end of the insulation.
4. Apply insulation for exterior applications tightly to the roof flashing (storm collar).
5. Seal metal jacket to roof flashing with vapor-retarder mastic.

P. Exterior Wall Penetrations: For penetrations of below-grade exterior walls, terminate insulation flush with mechanical sleeve seal. Seal terminations with vapor-retarder mastic.

Q. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.

R. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.

S. Floor Penetrations: Apply insulation continuously through floor assembly.

1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.3 MINERAL-FIBER INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Secure each layer of preformed pipe insulation to pipe as noted in the manufacturer's installation instructions.
2. Where vapor retarders are indicated, seal butt joints with vapor-retarder mastic or vapor barrier tape. Longitudinal seams to be sealed with factory provided adhesive lap system. Apply vapor retarder to ends of insulation at intervals of 15 to 20 feet to form a vapor retarder between pipe insulation

segments.

3. For insulation with factory-applied jackets, secure laps as noted in the manufacturer's installation instructions.

B. Apply insulation to flanges as follows:

1. Apply preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Where required for vapor barrier, seal ends of insulation with Vapor Barrier Mastic.

C. Apply insulation to fittings and elbows as follows:

1. Insulate fittings with glass-fiber blanket insulation or duct wrap, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire, tape, or bands.
2. Finish indoor fittings with standard PVC fitting covers.
3. Finish outdoor Welded Fittings with Aluminum Fitting covers.

D. Apply insulation to valves and specialties as follows:

1. Oversized Piping insulation or glass-fiber blanket insulation or duct wrap to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
2. Apply insulation to flanges as specified for flange insulation application.
3. Use preformed standard PVC fitting covers for valve sizes where available. Secure fitting covers with manufacturer's attachments and accessories. Seal seams with tape and/or vapor- retarder mastic.
4. For larger sizes where PVC fitting covers are not available, seal insulation with ASJ jacket and sealing compound recommended by the insulation material manufacturer.

3.4 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

A. Apply insulation to straight pipes and tubes as follows:

1. Follow manufacturer's written instructions for applying insulation.
2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Joints must be sealed to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to flanges as follows:

1. Apply pipe insulation to outer diameter of pipe flange.
2. Make width of insulation segment the same as overall width of the flange and bolts.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of the same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's

recommended adhesive. Joints must be sealed to avoid openings in insulation that will allow passage of air to the pipe surface.

C. Apply insulation to fittings and elbows as follows:

1. Where practical, slide Insulation through fittings
2. In conditions where insulation cannot slide through fittings, apply mitered sections of pipe insulation.
3. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

D. Apply insulation to valves and specialties as follows:

1. Apply preformed valve covers manufactured of the same material as pipe insulation and attached according to the manufacturer's written instructions.
2. Apply cut segments of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation. For check valves, fabricate removable sections of insulation arranged to allow access to strainer basket.
3. Apply insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.5 FIELD-APPLIED JACKET APPLICATION

A. Foil and Paper Jackets:

1. Apply foil and paper jackets where indicated.
2. Apply lap or joint strips with the same material as jacket.
3. Apply jackets with 2 inch laps at longitudinal seams.
4. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-retarder tape.

B. Aluminum Jacketing:

1. Apply metal jacket where insulated system is exposed to weather and where indicated for esthetics or abuse resistance
2. Provide Minimum 1-inch overlap at longitudinal seams and end joints.
3. Overlap longitudinal seams arranged to shed water.
4. Seal end joints with weatherproof sealant recommended by insulation manufacturer.
5. Secure jacket with Aluminum Bands (12" on Center) or Stainless-steel bands (12" on Center).

C. PVC Jacketing

1. Apply PVC Jacket where indicated for esthetics or abuse resistance
2. Provide minimum 1-inch overlap at longitudinal seams and end joints.

3. Seams to be secured self-seal lap system or with tacks.
4. Where required for washdown or located outdoors, seams of jacketing will be sealed with PVC welding adhesive.

3.6 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating for outdoor applications only.

1. The weather protection coating will provide complete protection to the insulation. No additional jacketing is required.

3.7 PIPING SYSTEM APPLICATIONS

A. Insulation materials and thicknesses are specified in schedules at the end of this Section.

B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:

1. Flexible connectors.
2. Vibration-control devices.
3. Fire-suppression piping.
4. Drainage piping located in crawl spaces.
5. Below-grade piping, unless otherwise indicated.
6. Chrome-plated pipes and fittings, unless potential for personnel injury.
7. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.
8. Heating Hot Water VAV Control Valves

3.8 INSULATION APPLICATION SCHEDULE, GENERAL

A. Refer to insulation application schedules for required insulation materials, vapor retarders, and field-applied jackets.

B. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

C. Roof Drains: Wrap roof drain sump with 1-1/2" thick fiberglass blanket and cover the fittings (elbows, laterals) with a pre-molded PVC cover.

D. INSULATION APPLICATION SCHEDULE

1. 2019 Building Energy Efficiency Standards – Table 120.3-A Pipe Insulation (Exhibit 1)

3.9 EXTERIOR INSULATION APPLICATION SCHEDULE

A. Same as above, with aluminum jacket. For piping insulation exposed to weather, use .016" aluminum jacket with one aluminum of Stainless Steel band per foot, seal penetrations with approved caulking.

END OF SECTION

Exhibit 1

TABLE 120.3-A PIPE INSULATION THICKNESS

Fluid Operating Temperature Range (°F)	Insulation Conductivity: Conductivity (in Btu·in/h·ft²·°F)	Insulation Conductivity: Mean Rating Temperature (°F)		Nominal Pipe Diameter (in inches): < 1	1 to <1.5	1.5 to < 4	4 to < 8	8 and larger
Space heating and Service Water Heating Systems (Steam, Steam Condensate, Refrigerant, Space Heating, Service Hot Water)				**Minimum Pipe Insulation Required (Thickness in inches or R-value)**				
Above 350	0.32-0.34	250	Inches	4.5	5.0	5.0	5.0	5.0
			R-value	R 37	R 41	R 37	R 27	R 23
251-350	0.29-0.32	200	Inches	3.0	4.0	4.5	4.5	4.5
			R-value	R 24	R 34	R 35	R 26	R 22
201-250	0.27-0.30	150	Inches	2.5	2.5	2.5	3.0	3.0
			R-value	R 21	R 20	R 17.5	R 17	R 14.5
141-200	0.25-0.29	125	Inches	1.5	1.5	2.0	2.0	2.0
			R-value	R 11.5	R 11	R 14	R 11	R 10
105-140	0.22-0.28	100	Inches	1.0	1.5	1.5	1.5	1.5
			R-value	R 7.7	R 12.5	R 11	R 9	R 8
				Nominal Pipe Diameter (in inches)				
				< 1	**1 to <1.5**	**1.5 to < 4**	**4 to < 8**	**8 and larger**
Space cooling systems (chilled water, refrigerant and brine)				**Minimum Pipe Insulation Required (Thickness in inches or R-value)[1]**				
40-60	0.21-0.27	75	Inches	Nonres 0.5 / Res 0.75		Nonres 0.5 / Res 0.75		1.0	1.0	1.0
			R-value	Nonres R 3 / Res R 6		Nonres R 3 / Res R 5		R 7	R 6	R 5
Below 40	0.20-0.26	50	Inches	1.0		1.5		1.5	1.5	1.5
			R-value	R 8.5		R 14		R 12	R 10	R 9

Footnote to TABLE 120.3-A:

1. These thickness are based on energy efficiency considerations only. Issues such as water vapor permeability or surface condensation sometimes require vapor retarders or additional insulation.

EXCEPTION 1 to Section 120.3: Factory-installed piping within space-conditioning equipment certified under Section 110.1 or 110.2.

EXCEPTION 2 to Section 120.3: Piping that conveys fluids with a design operating temperature range between 60°F and 105°F.

EXCEPTION 3 to Section 120.3: Where the heat gain or heat loss to or from piping without insulation will not increase building source energy use.

EXCEPTION 4 to Section 120.3: Piping that penetrates framing members shall not be required to have pipe insulation for the distance of the framing penetration. Metal piping that penetrates metal framing shall use grommets, plugs, wrapping or other insulating material to assure that no contact is made with the metal framing.

NOTE: Authority: Sections 25213, 25218, 25218.5, 25402 and 25402.1, Public Resources Code. Reference: Sections 25007, 25008, 25218.5, 25310, 25402, 25402.1, 25402.4, 25402.5, 25402.8, and 25943, Public Resources Code.