

**SECTION 22 07 11
PLUMBING INSULATION**

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Field applied insulation for thermal efficiency and condensation control for
 - 1. Plumbing piping and equipment.
- B. Definitions
 - 1. ASJ: All service jacket, white finish facing or jacket.
 - 2. Air conditioned space: Space having air temperature and/or humidity controlled by mechanical equipment.
 - 3. Cold: Equipment or piping handling media at design temperature of 16 degrees C (60 degrees F) or below.
 - 4. Concealed: Piping above ceilings and in chases and pipe spaces.
 - 5. Exposed: Piping and equipment exposed to view in finished areas including mechanical equipment rooms or exposed to outdoor weather. Shafts, chases, and pipe basements are not considered finished areas.
 - 6. FSK: Foil-scrim-kraft facing.
 - 7. Hot: Plumbing equipment or piping handling media above 41 degrees C (105 degrees F).
 - 8. Density: kg/m^3 - kilograms per cubic meter (Pcf - pounds per cubic foot).
 - 9. Thermal conductance: Heat flow rate through materials.
 - a. Flat surface: Watts per square meter (BTU per hour per square foot).
 - b. Pipe or Cylinder: Watts per square meter (BTU per hour per linear foot).
 - 10. Thermal Conductivity (k): Watt per meter, per degree C (BTU per inch thickness, per hour, per square foot, per degree F temperature difference).
 - 11. Vapor Retarder (Vapor Barrier): A material which retards the transmission (migration) of water vapor. Performance of the vapor retarder is rated in terms of permance (perms). For the purpose of this specification, vapor retarders shall have a maximum published permance of 0.1 perms and vapor barriers shall have a maximum published permance of 0.001 perms.
 - 12. HR: Hot water recirculation piping.

13. CW: Cold water.

14. HW: Hot water.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Mineral fiber and bond breaker behind sealant.
- B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General mechanical requirements and items, which are common to more than one section of Division 22.
- C. Section 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING: Hot and cold water piping.
- D. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS. Requirements for commissioning, systems readiness checklists, and training.

1.3 QUALITY ASSURANCE

- A. Refer to article QUALITY ASSURANCE, in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

- B. Criteria:

- 1. Comply with NFPA 90A, particularly paragraphs 4.3.3.1 through 4.3.3.6, 4.3.10.2.6, and 5.4.6.4, parts of which are quoted as follows:

4.3.3.1 Pipe insulation and coverings, vapor retarder facings, adhesives, fasteners, tapes, unless otherwise provided for in 4.3.3.1.12 or 4.3.3.1.2, shall have, in the form in which they are used, a maximum flame spread index of 25 without evidence of continued progressive combustion and a maximum smoke developed index of 50 when tested in accordance with NFPA 255, *Standard Method of Test of Surface Burning Characteristics of Building Materials*.

4.3.3.1.1 Where these products are to be applied with adhesives, they shall be tested with such adhesives applied, or the adhesives used shall have a maximum flame spread index of 25 and a maximum smoke developed index of 50 when in the final dry state. (See 4.2.4.2.)

4.3.3.3 Pipe insulation and coverings shall not flame, glow, smolder, or smoke when tested in accordance with a similar test for pipe covering, ASTM C 411, Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation, at the temperature to which they are exposed in service.

4.3.3.3.1 In no case shall the test temperature be below 121°C (250°F).

- 2. Test methods: ASTM E84, UL 723, or NFPA 255.
- 3. Specified k factors are at 24 degrees C (75 degrees F) mean temperature unless stated otherwise. Where optional thermal insulation material is used, select thickness to provide thermal

conductance no greater than that for the specified material. For pipe, use insulation manufacturer's published heat flow tables. For domestic hot water supply and return, run out insulation and condensation control insulation, no thickness adjustment need be made.

4. All materials shall be compatible and suitable for service temperature, and shall not contribute to corrosion or otherwise attack surface to which applied in either the wet or dry state.

C. Every package or standard container of insulation or accessories delivered to the job site for use must have a manufacturer's stamp or label giving the name of the manufacturer and description of the material.

1.4 SUBMITTALS

A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Shop Drawings:

1. All information, clearly presented, shall be included to determine compliance with drawings and specifications and ASTM, federal and military specifications.
 - a. Insulation materials: Specify each type used and state surface burning characteristics.
 - b. Insulation facings and jackets: Each type used.
 - c. Insulation accessory materials: Each type used.
 - d. Manufacturer's installation and fitting fabrication instructions for flexible unicellular insulation.
 - e. Make reference to applicable specification paragraph numbers for coordination.

1.5 STORAGE AND HANDLING OF MATERIAL

Store materials in clean and dry environment, pipe covering jackets shall be clean and unmarred. Place adhesives in original containers. Maintain ambient temperatures and conditions as required by printed instructions of manufacturers of adhesives, mastics and finishing cements.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by basic designation only.
- B. Military Specifications (Mil. Spec.):

MIL-A-3316C (2)-90.....Adhesives, Fire-Resistant, Thermal Insulation

MIL-A-24179A (1)-87.....Adhesive, Flexible Unicellular-Plastic

Thermal Insulation

MIL-C-19565C (1)-88.....Coating Compounds, Thermal Insulation, Fire-and

Water-Resistant, Vapor-Barrier

MIL-C-20079H-87.....Cloth, Glass; Tape, Textile Glass; and Thread,

Glass and Wire-Reinforced Glass

C. American Society for Testing and Materials (ASTM):

C534-08Standard Specification for Preformed Flexible

Elastomeric Cellular Thermal Insulation in

Sheet and Tubular Form

C547-07Standard Specification for Mineral Fiber pipe

Insulation

C585-09.....Standard Practice for Inner and Outer Diameters

of Rigid Thermal Insulation for Nominal Sizes

of Pipe and Tubing (NPS System) R (1998)

C1136-10Standard Specification for Flexible, Low

Permeance Vapor Retarders for Thermal

Insulation

E84-10Standard Test Method for Surface Burning

Characteristics of Building

Materials

E119-09C.....Standard Test Method for Fire Tests of Building

Construction and Materials

E136-09 b.....Standard Test Methods for Behavior of Materials

in a Vertical Tube Furnace at 750 degrees C

(1380 F)

D. National Fire Protection Association (NFPA):

101-09Life Safety Code

251-06.....Standard methods of Tests of Fire Endurance of

Building Construction Materials

255-06.....Standard Method of tests of Surface Burning

Characteristics of Building Materials

E. Underwriters Laboratories, Inc (UL):

723.....UL Standard for Safety Test for Surface Burning
 Characteristics of Building Materials with
 Revision of 08/03

- F. Manufacturer's Standardization Society of the Valve and Fitting
 Industry (MSS):
 SP58-2002.....Pipe Hangers and Supports Materials, Design,
 and Manufacture

PART 2 - PRODUCTS

2.1 FIBER GLASS

- A. ASTM C547 (Pipe Fitting Insulation and Preformed Pipe Insulation),
 Class 1, $k = 0.037$ (0.26) at 24 degrees C (75 degrees F), for use at
 temperatures up to 230 degrees C (450 degrees F) with an all service
 vapor retarder jacket with polyvinyl chloride premolded fitting
 covering.

2.2 FLEXIBLE ELASTOMERIC CELLULAR THERMAL

- A. ASTM C177, C518, $k = 0.039$ (0.27) at 24 degrees C (75 degrees F), flame
 spread not over 25, smoke developed not over 50, for temperatures from
 minus 4 degrees C (40 degrees F) to 93 degrees C (200 degrees F). No
 jacket required.

2.3 INSULATION FACINGS AND JACKETS

- A. Vapor Retarder, higher strength with low water permeance ≤ 0.02 or less
 perm rating, Beach puncture 50 units for insulation facing on pipe
 insulation jackets. Facings and jackets shall be all service type (ASJ)
 or PVDC Vapor Retarder jacketing.
- B. ASJ jacket shall be white kraft bonded to 0.025 mm (1 mil) thick
 aluminum foil, fiberglass reinforced, with pressure sensitive adhesive
 closure. Comply with ASTM C1136. Beach puncture 50 units, Suitable for
 painting without sizing. Jackets shall have minimum 40 mm (1-1/2 inch)
 lap on longitudinal joints and minimum 75mm (3 inch) butt strip on end
 joints. Butt strip material shall be same as the jacket. Lap and butt
 strips shall be self-sealing type with factory-applied pressure
 sensitive adhesive.
- C. Vapor Retarder medium strength with low water vapor permeance of 0.02
 or less perm rating), Beach puncture 25 units: Foil-Scrim-Kraft (FSK)
 or PVDC vapor retarder jacketing type for concealed ductwork and
 equipment.
- D. Pipe fitting insulation covering (jackets): Fitting covering shall be
 premolded to match shape of fitting and shall be polyvinyl chloride

(PVC) conforming to Fed Spec L-P-335, composition A, Type II Grade GU, and Type III, minimum thickness 0.7 mm (0.03 inches). Provide color matching vapor retarder pressure sensitive tape.

2.4 PIPE COVERING PROTECTION SADDLES

- A. Cold pipe support: Premolded pipe insulation 180 degrees (half-shells) on bottom half of pipe at supports. Material shall be cellular glass or high density Polyisocyanurate insulation of the same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

Nominal Pipe Size and Accessories Material (Insert Blocks)	
Nominal Pipe Size mm (inches)	Insert Blocks mm (inches)
Up through 125 (5)	150 (6) long
150 (6)	150 (6) long

- B. Warm or hot pipe supports: Premolded pipe insulation (180 degree half-shells) on bottom half of pipe at supports. Material shall be high density Polyisocyanurate (for temperatures up to 149 degrees C [300 degrees F]), cellular glass or calcium silicate. Insulation at supports shall have same thickness as adjacent insulation. Density of Polyisocyanurate insulation shall be a minimum of 48 kg/m³ (3.0 pcf).

2.5 ADHESIVE, MASTIC, CEMENT

- A. Mil. Spec. MIL-A-3316, Class 1: Jacket and lap adhesive and protective finish coating for insulation.
- B. Mil. Spec. MIL-A-24179, Type II Class 1: Adhesive for installing flexible unicellular insulation and for laps and general use.
- C. Other: Insulation manufacturers' published recommendations.

2.6 MECHANICAL FASTENERS

- A. Staples: Outward clinching galvanized steel

2.7 REINFORCEMENT AND FINISHES

- A. Tape for Flexible Elastomeric Cellular Insulation: As recommended by the insulation manufacturer.
- B. PVC fitting cover: Fed. Spec L-P-535, Composition A, 11-86 Type II, Grade GU, with Form B Mineral Fiber insert, for media temperature 4 degrees C (40 degrees F) to 121 degrees C (250 degrees F). Below 4 degrees C (40 degrees F) and above 121 degrees C (250 degrees F). Provide double layer insert. Provide color matching vapor barrier pressure sensitive tape.

2.8 FIRESTOPPING MATERIAL

Other than pipe insulation, refer to Section 07 84 00 FIRESTOPPING.

2.9 FLAME AND SMOKE

Unless shown otherwise all assembled systems shall meet flame spread 25 and smoke developed 50 rating as developed under ASTM, NFPA and UL standards and specifications. See paragraph 1.3 "Quality Assurance".

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

- A. Required pressure tests of piping joints and connections shall be completed and the work approved by the Resident Engineer for application of insulation. Surface shall be clean and dry with all foreign materials, such as dirt, oil, loose scale and rust removed.
- B. Except for specific exceptions, insulate all specified equipment, and piping (pipe, fittings, valves, accessories). Insulate each pipe individually. Do not use scrap pieces of insulation where a full length section will fit.
- C. Insulation materials shall be installed in a first class manner with smooth and even surfaces, with jackets and facings drawn tight and smoothly cemented down at all laps. Insulation shall be continuous through all sleeves and openings. Vapor retarders shall be continuous and uninterrupted throughout systems with operating temperature 16 degrees C (60 degrees F) and below. Lap and seal vapor barrier over ends and exposed edges of insulation. Anchors, supports and other metal projections through insulation on cold surfaces shall be insulated and vapor sealed for a minimum length of 150 mm (6 inches).
- D. Install vapor stops at all insulation terminations on either side of valves, pumps and equipment and particularly in straight lengths of pipe insulation.
- E. Insulation on hot piping shall be terminated square at items not to be insulated, access openings and nameplates. Cover all exposed raw insulation with white sealer or jacket material.
- F. Plumbing work not to be insulated:
 - 1. Piping and valves of fire protection system.
 - 2. Chromium plated brass piping.
- G. Apply insulation materials subject to the manufacturer's recommended temperature limits. Apply adhesives, mastic and coatings at the manufacturer's recommended minimum coverage.

H. Elbows, flanges and other fittings shall be insulated with the same material as is used on the pipe straights.

Use of polyurethane spray-foam to fill a PVC elbow jacket is prohibited on cold applications.

I. Firestop Pipe insulation:

1. Provide firestopping insulation at fire and smoke barriers through penetrations. Fire stopping insulation shall be UL listed as defines in Section 07 84 00, FIRESTOPPING.
2. Pipe penetrations requiring fire stop insulation including, but not limited to the following:
 - a. Pipe risers through floors
 - b. Pipe chase walls and floors
 - c. Smoke partitions
 - d. Fire partitions

J. Freeze protection of above grade outdoor piping (over heat tracing tape): 20 mm (0.75) thick insulation, for all pipe sizes 75 mm(3 inches) and smaller and 25 mm(1inch) thick insulation for larger pipes.

K. Provide vapor barrier jackets over insulation as follows:

1. All piping exposed to outdoor weather.

3.2 INSULATION INSTALLATION

A. Fiberglass Pipe and Tubing Covering:

1. Fit insulation to pipe, aligning longitudinal joints. Seal longitudinal joint laps and circumferential butt strips by rubbing hard with a nylon sealing tool to assure a positive seal. Staples may be used to assist in securing insulation. Seal all vapor retarder penetrations on cold piping with a generous application of vapor barrier mastic. Provide inserts and install with metal insulation shields at outside pipe supports. Install freeze protection insulation over heating cable.
2. Contractor's options for fitting, flange and valve insulation:
 - a. Factory premolded, one piece PVC covers with mineral fiber, (Form B), inserts. Provide two insert layers for pipe temperatures below 4 degrees C (40 degrees F), or above 121 degrees C (250 degrees F). Secure first layer of insulation with twine. Seal seam edges with vapor barrier mastic and secure with fitting tape.
 - b. Fitting tape shall extend over the adjacent pipe insulation and overlap on itself at least 50 mm (2 inches).

3. Nominal thickness in millimeters and inches specified in the schedule at the end of this section.

B. Flexible Elastomeric Cellular Thermal Insulation:

1. Apply sheet insulation to flat or large curved surfaces with 100 percent adhesive coverage. For fittings and large pipe, apply adhesive to seams only.
2. Pipe insulation: nominal thickness in millimeters (inches as specified in the schedule at the end of this section).

3.3 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS for all inspection, start up, and contractor testing required above and required by the System Readiness Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to section 22 08 00 - COMMISSIONING OF PLUMBING SYSTEMS and related sections for contractor responsibilities for system commissioning.

3.4 PIPE INSULATION SCHEDULE

Provide insulation for piping systems as scheduled below:

Insulation Thickness Millimeters (Inches)					
		Nominal Pipe Size Millimeters (Inches)			
Operating Temperature Range/Service	Insulation Material	Less than 25 (1)	25 - 32 (1 - 1½)	38 - 75 (1½ - 3)	100 (4) and Above
38-60 degrees C (100-140 degrees F) (Domestic Hot Water Supply and Return)	Fiberglass (Above ground piping only)	38 (1.5)	38 (1.5)	50 (2.0)	----
4-16 degrees C (40-60 degrees F) (Domestic cold water piping)	Fiberglass (Above ground piping only)	25 (1.0)	25 (1.0)	25 (1.0)	----
Roof Conductors	Fiberglass	----	----	----	All sizes (1.0)
Roof drain bowl and	Flexible	----	----	----	All sizes

underside of sump receivers	Elastomeric sheet insulation				(1.0)
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