

**SECTION 22 07 00
INSULATION FOR PLUMBING**

PART 1 – GENERAL

1.01 WORK INCLUDED

- A. The work of this Section shall include, but is not limited to, the following:
 - 1. Piping insulation, jackets
 - 2. Equipment insulation and covering

1.02 RELATED DOCUMENTS

- A. Section 22 05 01 – Plumbing General Provisions
- B. Section 22 11 00 – Domestic Water Systems
- C. Section 22 11 10 – Plumbing Piping and Accessories
- D. Section 22 11 30 – Reclaimed Water Systems
- E. Section 22 13 00 – Drainage Systems
- F. Section 22 33 00 – Domestic Water Heating Systems

1.03 REFERENCE STANDARDS

Published specifications standards, tests or recommended methods of trade, industry or governmental organizations apply to work in this Section where cited below:

- A. ASTM – American Society for Testing and Materials
 - 1. ASTM B209 – 2007: Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 - 2. ASTM C518 – 2004: Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - 3. ASTM C533 – 2007: Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
 - 4. ASTM C534/C534M – 2011: Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form
 - 5. ASTM C553 – 2008: Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Application
 - 6. ASTM C547 – 2012: Standard Specification for Mineral Fiber Pipe Insulation
 - 7. ASTM C612 – 2004 Revised 2009: Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - 8. ASTM E84 – 2012: Standard Test Method for Surface Burning Characteristics of Building Materials
 - 9. ASTM E96 – 2012: Standard Test Methods for Water Vapor Transmission of Materials
 - 10. ASTM F1249 – 2011: Standard Test Method for Water Vapor Transmission Rate
- B. NFPA – National Fire Protection Association

- 1. NFPA 225, Edition 09 – Model Manufactured Home Installation Standard
 - C. UL – Underwriters Laboratories Inc.
 - 1. UL 723 – 2008: Test for Surface Burning Characteristics of Building Materials
 - D. International Plumbing Code
 - E. International Building Code
 - F. International Energy Code
- 1.04 QUALITY ASSURANCE
- A. All insulation shall be in accordance with **applicable codes**.
 - B. Insulation supplier and insulation installer shall have a minimum of 5 years' successful installation experience on projects of similar scope to this project.
- 1.05 SUBMITTALS
- A. Product Data: Provide product description, current Product Data Sheets, list of materials and thickness for each service or equipment scheduled, locations, and manufacturer's installation instructions.
 - B. Submit details of sheet metal boxes for pieces of insulated equipment. Refer to Paragraph 2.05A.6.
 - C. Quality Assurance / Control Submittals:
 - 1. Certificates: Submit manufacturer's certificate that product(s) meet or exceed specified requirements.
- 1.06 ENVIRONMENTAL REQUIREMENTS
- A. Maintain ambient temperatures and conditions during storage and installation of all products required by manufacturers of adhesives, mastics, and insulation cements.
 - B. Protect insulation from contact with water.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

- A. Fiberglass: Johns Manville, Knauf, Owens Corning.
- B. Calcium Silicate: Johns Manville, Extol of Ohio, Inc.
- C. Elastomeric: Armacell, Aeroflex.
- D. Cellular Glass: Pittsburgh Corning.
- E. Mastics, Adhesives and Sealers: Ductmate, Benjamin Foster (BF), IC, 3M; Childers.

1. Vapor Barrier Mastic: Foster 30-65, Childers CP-34, IC-501. Permeance shall be 0.03 perms or less at 45 mils per ASTM E96. Product must comply with California Department of Public Health (CDPH) Standard Method Ver. 1.1, 2010 Small Scale Environmental Chamber Test for VOCs for California Specification 01350.
2. Weather Barrier Breather Mastic: Foster 46-50, Childers CP-10/11 or approved equal.
3. Lagging Adhesive/Coating: Foster 30-36, Childers CP-50AMV1 or approved equal.
4. Reinforcing Mesh: Foster Mast a Fab, Childers Chil Glas #10.
5. Calcium Silicate Insulation Adhesive: Foster 81-27, Childers CP-97, Vimasco 760.
6. Fiberglass Insulation Adhesive: Foster 85-60, Childers CP-127, or approved equal. Comply with ASTM C916, Type II.
7. Metal Jacketing/Flashing Sealant: Foster 95-44, Childers CP-76 or approved equal.

F. Jackets:

1. Metal: Childers, RPR Products.
2. PVC: Ceel-Co, PIC Plastics.
3. Other: Venture Tape, Polyguard, Foster Vapor Fas 62-05.

G. Pre-Molded Fittings, Valves, Strainers and Equipment Insulation: Insul-Therm International, Extol of Ohio, Inc., or approved equal.

2.02 GENERAL

- A. Conform to application schedule for type and thickness of insulation.
- B. Insulation, jacket, facing and adhesives shall be non-combustible material meeting Code requirements and fire and smoke hazard ratings as tested by procedure ASTM E84, National Fire Protection Association 225, and UL 723, not exceeding Flame Spread 25 and Smoke Developed 50.
- C. Adhesive, mastic or insulating material shall not contain asbestos.
- D. Vapor jacket permeance shall be 0.02 perms or less.
- E. Jacket puncture resistance shall be 50 units (Beach) or greater.

2.03 PIPE INSULATION MATERIALS

- A. Glass Fiber: ASTM C547; rigid molded, non-combustible.
 1. Installed 'K' Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
 2. Maximum Service Temperature: 850 degrees F.
 3. Vapor Retarder Jacket: White kraft paper, vinyl coated, embossed and reinforced with glass fiber yarn and bonded to aluminum foil, secure with self-sealing longitudinal laps and butt strips.
- B. Hydrous Calcium Silicate: ASTM C533; rigid molded pipe.
 1. Installed 'K' Value: 0.40 BTU-inch per hour-foot²-degree F at 300 degrees F.
 2. Maximum Service Temperature: 1200 degrees F.

3. Tie Wire: 16-gauge stainless steel with twisted ends on maximum 12-inch centers.
- C. Elastomeric Foam: ASTM C534/C 534M flexible cellular elastomeric, molded or sheet.
1. Installed 'K' Value: 0.27 BTU-inch per hour-foot²-degree F at 75 degrees F.
 2. Maximum Service Temperature: 220 degrees F.
- D. Cellular Glass:
1. Inorganic, foamed or cellulated glass, annealed, rigid, hermetically sealed cells, incombustible.
 2. Preformed Pipe Insulation with Jacket: Comply with ASTM C552, Type II, Class 2.
- E. Field-Applied Jackets:
1. PVC Plastic (PVC): One-piece molded type fitting covers and sheet material, gloss white. Connections shall be pressure-sensitive color-matching vinyl tape.
 2. Canvas Jacket (CJ): UL Listed fabric, 6 ounce per square yard, plain weave cotton treated with dilute fire-retardant lagging adhesive.
 3. Aluminum Jacket (AL): 0.016-inch thick sheet, stippled finish, with longitudinal slip joints and 2-inch laps, die-shaped fitting covers with factory-attached protective liner.
 4. Stainless Steel Jacket (SSJ): Type 304 stainless steel, 0.010 inch, smooth finish.
 5. Vapor Barrier Jacket (VBJ): Five ply, non-bituminous embossed aluminum foil/laminated film with permeance rating 0.0 as tested in accordance with ASTM F1249. Venture Clad Plus (1579CW) by Venure Tape, Polyguard Zero-Perm (indoors only), Foster Vapor Fas 62-05 or approved equal.

2.04 PIPE INSULATION SCHEDULES

A. Insulation Schedules for systems other than Domestic (and Industrial) Hot Water:

Service	Temperature Range (degrees F)	Material	Insulation Thickness (inches) for Pipe Sizes (inches):					
			Less than 1	1 to 1-1/4	1-1/2 to 2	2 1/2 to 4	5 to 6	8 and up
Domestic cold water	40 to 60	Elastomeric foam, glass fiber, cellular glass	1	1	1	1	1	1
Underground piping	All	Pre-insulated pipe	Refer to Section 22 11 10 – Piping and Accessories					
HVAC equipment condensate drains (i.e. bodies and piping)	All	Elastomeric foam, glass fiber	1/2	1/2	1/2	-	-	-
Roof drain bodies and vertical drop to horizontal piping	All	Glass fiber	-	-	1 1/2	1 1/2	1 1/2	1 1/2
Horizontal roof drainage piping and	All	Glass fiber	-	-	1 1/2	1 1/2	1 1/2	1 1/2

first 18 inches of vertical riser								
Plumbing vents within 10 feet of atmosphere	All	Glass fiber	-	-	1	1	1	1
Heat-traced piping	All	Glass fiber	1½	1½	1½	1½	1½	1½
Additional insulation greater than values shown in this table for outdoor piping subject to freezing but not heat-traced	All	Glass fiber	2 (in addition to the standard requirements in this table)					
Hot water and drain piping below lavatories	All	Refer to Section 22 40 00	-	-	-	-	-	-

B. Insulation Schedule for Domestic (and Industrial) Hot Water Piping:

Service	Temperature Range (degrees F)	Material	Insulation Thickness (inches) for Pipe Sizes (inches):				
			Less than 1	1 to 1-1/4	1-1/2 to 3-1/2	4 to 6	8 and larger
Domestic hot water, domestic recirculated hot water	105 to 140	Glass fiber	1	1½	1½	1½	1½

C. Fittings, Valves and Flanges:

1. Use factory pre-molded fittings of the same materials and thickness as the adjacent pipe insulation. Such fittings shall be applied to all 90°s, 45°s, Tee's, flanges, and valves.
2. Where pre-molded insulation fittings are not manufactured, insulate fittings, flanges, strainers and valves with mitered segments of the same density as the adjoining pipe covering. Vaporseal for cold (below dew point) applications using vapor barrier mastic with open weave glass or polyester mesh lay in while wet. Provide a final coat of vapor barrier mastic. Overlap glass mesh and outer coat adjacent covering by a minimum of 2 inches. Vapor barrier mastic shall be IC 501. Childers CP-34 or 30-Permeance of mastic shall be 0.03 perms or less at 45 mils as tested by ASTM E96. Reinforcing mesh shall be foster Mast a Fab, Childers Chil Glas #10 or approved equal.
3. Provide insulation for the removable covers and flanges of pipe strainers on cold services with built-up sections of glass fiber pipe covering, arranged to facilitate servicing of the strainer. Complete applications with vaporseals as specified above. Vapor barriers shall be sealed and continuous through guides, hangers, walls, sleeves, etc. Adhesives and coatings shall be as noted herein.

D. Jacketing Schedule:

Service	Location	Jacket Type
Domestic hot water	Exposed in Plant Rooms	AL

Service	Location	Jacket Type
Condensate	All locations	ASJ or painted finish
Domestic cold water	[Service entry to first take off] [Minimum 25 feet from service entry]	ASJ
Outdoor piping	All locations	AL

2.05 EQUIPMENT INSULATION

A. Materials:

1. Flexible Fiberglass Blanket: ASTM C553.
 - a. Installed 'K' Value: 0.24 at 75 degrees F.
 - b. Maximum Service Temperature: 450 degrees F.
 - c. Density: 6.0 pounds per cubic foot.
 - d. Vapor Retarder Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with UL Listed pressure-sensitive tape and outward clinch expanding staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.02 perms.
2. Rigid Fiberglass Board: ASTM C612.
 - a. Installed 'K' Value: 0.23 BTU-inch per hour-foot²-degree F at 75 degrees F.
 - b. Maximum Service Temperature: 450 degrees F.
 - c. Density: 6.0 pounds per cubic foot.
 - d. Vapor Retarder Jacket: Aluminum foil reinforced with fiberglass yarn and laminated to fire-resistant kraft paper, secured with UL Listed pressure-sensitive tape and outward clinch expanding staples and vapor barrier mastic as needed. Maximum vapor barrier perm rating shall not exceed 0.5 perms.
 - e. Facing: 1-inch galvanized hexagonal wire mesh stitched on one face of insulation.
3. Hydrous Calcium Silicate: ASTM C533, rigid molded block.
 - a. Installed 'K' Value: 0.40 BTU-inch per hour-foot²-degree F at 300 degrees F.
 - b. Maximum Service Temperature: 1200 degrees F.
 - c. Attachment: Insulation shall be securely banded in place, tightly butted, joints staggered and secured with 16 gauge stainless steel wire or ½-inch by 0.015 inch galvanized steel bands on 12-inch maximum centers for large areas.
4. Elastomeric Foam: ASTM C534, flexible cellular elastomeric, molded or sheet.
 - a. Installed 'K' Value: 0.27 BTU-inch per hour-foot²-degree F at 75 degrees F.
 - b. Maximum Service Temperature: 220 degrees F.

5. Apply the vaporseal board by mechanical fasteners such as Graham pins and speed washers. Seal joints with an adhesive, as approved and reinforced with a glass cloth membrane over vinyl mastic, or self-sealing matching tape. Cover pinheads with adhesive, as specified. If vaporseal board is wired, use sheet metal edges to protect the corners of the board from the wire. Seal edges and joints.
6. Enclose removable covers or heads for equipment, (such as strainers, heat exchangers and pumps) in aluminum sheet metal boxes for easy removal with fiberglass board applied to inside of sheet metal boxes of thickness as described above. Provide lifting handles for removal of boxes.
7. Install equipment insulation in accordance with manufacturer's instructions.

B. Mastics, Adhesives and Sealants

1. Apply in accordance with manufacturer's written instructions.

C. Equipment Insulation Schedule:

Service	Material	Thickness (inches)
Domestic hot water storage and expansion tanks, shell and tube heat exchangers	Flexible glass fiber	2
Domestic cold water pumps and domestic water plate heat exchangers	Glass fiber board	2

PART 3 – EXECUTION

3.01 EXAMINATION AND PREPARATION

- A. Verify that all surfaces are clean, dry and free of dirt, duct, debris, moisture or foreign material.

3.02 INSTALLATION

- A. Install materials in accordance with manufacturer's recommendations, building codes and industry standards.
- B. Verify piping has been pressure-tested as specified in Section 22 11 10 – Plumbing Piping and Accessories before applying insulation materials to pipe joints.
- C. Continue insulation and vapor barrier through penetrations.
- D. Piping, Valve and Accessories Insulation:
 1. Insulate domestic water supply lines inside chases and up to the plumbing fixture supply stop.
 2. Locate insulation and cover seams in least visible locations where exposed.
 3. Neatly finish insulation at supports, protrusions, and interruptions.
 4. Provide insulated pipes, fittings, valves and accessories conveying fluids below ambient temperature with continuous vapor retarder jackets with self-sealing laps. Insulate complete system and provide molded flexible polyvinyl chloride jacket(s) for all fittings and valves. Vaporseal all below ambient jacket seams with vapor barrier mastic as recommended by the insulation manufacturer.
 5. For insulated pipes, fittings, valves and accessories conveying fluids above

ambient temperature, secure jackets with self-sealing lap. Bevel and seal ends of insulation at equipment, flanges and unions.

6. Protect pipe insulation at hangers, guides, and rollers with 20-gauge galvanized metal shields, one-third the insulation circumference in width and minimum 10 inches in length up to 2½-inch pipe size, 12 inches in length on pipes 3-inch and larger, on the outside of the insulation and vapor barrier or jacket. Center shield on hanger and hold shield in place by straps or by manufactured centering tabs or channels on the shield itself. Do not pierce the insulation with hangers.
7. Provide insert between support shield and piping. Fabricate of calcium silicate, rigid phenolic or other heavy density non-deforming insulating material suitable for temperature. Length of insulation inserts shall match support shield length as specified.
8. For exterior applications or locations where abrasion or damage may occur, provide weather protection jacket. Insulated pipe, fittings, accessories joints, and valves shall be covered with ultra-violet light-resistant painted polyvinyl chloride, Foster Vapor Fas 62-05 flexible jacketing, or aluminum jacket. Jacket seams shall be located on bottom side of horizontal piping.
9. Apply prefabricated sectional insulation for straight pipes neatly fitted around the piping, and sealed with adhesive. Apply adhesive to only one side of each joint and not to pipe surface.
10. Seal all joints with Foster 30-35 or Childers CP-34 fire-resistant vapor barrier mastic. Oversized pipe sections or board type insulation may be used to fabricate and install insulation around pipe specialties. All void spaces shall be firmly filled with flexible insulation to support oversized pipe insulation.
11. Secure sectional insulation with 0.02-inch thick by ½-inch wide aluminum bands manufactured by Childers, or RPR Products nylon ties, on 24-inch centers for pipe sizes 2 inches and larger. Install at least two (2) bands per section of insulation.
12. Insulate domestic cold water vertical riser support clamps.
13. Insulate and thoroughly vaporseal control valve bodies where the valve actuator penetrates the insulation.
14. Thoroughly vaporseal the ends of all domestic cold water pipe, valve and fitting insulation sections to prevent condensation from wicking between sections.
15. Replace any self-sealing insulation or lap that is found to be not sealing properly. Do not use staples to secure the insulation or coverings.

E. Equipment Insulation:

1. 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.
2. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor-retardant cement.
3. Provide cold equipment containing fluids below ambient temperature with vapor-retardant jackets.
4. For insulated equipment containing fluids above ambient temperature, provide jacket with or without vapor barrier.
5. Cover insulation with metal mesh and finish with ½-inch thick insulating cement, or aluminum jacket.
6. Do not insulate over sight glasses, visual level or flow indicators, nameplates or ASME stamps. Bevel and seal insulation around these items.
7. 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 to insulation or vapor barrier.

8. Hot equipment insulation shall be covered with ½-inch thick insulating cement over copper-clad hexagonal wire.
9. Cold equipment insulation shall be covered with ½-inch thick insulating cement over vaporseal mastic and copper-clad hexagonal wire.

END OF SECTION 22 07 00

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