

SECTION 15083 – HVAC PIPING INSULATION

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

- A. Furnish and install all piping insulation, vapor barriers, jackets, finishes, adhesives, cements and accessories to make a complete insulated system for all piping, valves, fittings, joints, offsets and flanges specified herein.
- B. All insulation system materials shall conform to the maximum flame spread/smoke developed ratings specified herein.
- C. Hard insulation material shall be provided at all hangers.
- D. Insulate the following:
 - 1. All scheduled piping, all valves, fittings, elbows, flanges and accessories.
 - 2. All piping exposed to weather including provision of additional weatherproof jacket.
 - 3. All cold water make-up piping and valves. All drain and overflow piping receiving cold water. Piping to/from expansion/compression tanks.
 - 4. All vents and blow-offs in mechanical rooms and elsewhere within reach of personnel.
 - 5. Piping jacket covers.
 - 6. All heat traced piping.

1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Section of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as follows:

1. ASTM A 666 – Standard Specification for Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.
2. ASTM B 209 – Standard Specification for Aluminum and Aluminum-Alloy Steel and Plate.
3. ASTM B 209M – Standard Specification for Aluminum and Aluminum-Alloy Sheet and plate (Metric).
4. ASTM C 177 – Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.
5. ASTM C 195 – Standard Specification for Mineral Fiber Thermal Insulating Cement.
6. ASTM C 240 – Standard Test Methods of Testing Cellular Glass Insulation Block.
7. ASTM C 449/C 449M – Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
8. ASTM C 518 – Standard Test method for Steady-State Heat Flux Measurements and Thermal Insulating and Finishing Cement.
9. ASTM C 533 – Standard Specification for Calcium Silicate Block and Pipe Terminal Insulation.
10. ASTM C 534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
11. ASTM C 547 – Standard Specification for Mineral Fiber Pipe Insulation.
12. ASTM C 552 – Standard Specification for Cellular Glass Thermal Insulation.
13. ASTM C 578 – Standard Specification for Preformed, Cellular Polystyrene Thermal Insulation.
14. ASTM C 591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
15. ASTM C 610 – Standard Specification for Molded Expanded Perlite Block and Pipe Thermal Insulation.
16. ASTM C 795 – Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
17. ASTM C 921 – Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.
18. ASTM D 1056 – Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.
19. ASTM D 1667 – Standard Specification for Flexible Cellular Materials – vinyl Chloride Polymers and Copolymers (Closed-Cell Foam).
20. ASTM D 1784 – Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
21. ASTM D 2842 – Standard Test Method for Water Absorption of Rigid Cellular Plastics.
22. ASTM E 84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
23. ASTM E 96 – Standard Test Methods for Water Vapor Transmission Materials.
24. NFPA 225 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
25. UL 723 – Standard for Test for Surface Burning Characteristics of Building Materials.
26. ANSI/ASHRAE 90.1 – Energy Conservation in New Buildings.

1.5 SUBMITTALS

- A. See Section 15050 and General Conditions for Additional Requirements.
- B. Product Data: Provide product description, thermal characteristics, list of materials and thickness for each service, and locations.
- C. Manufacturer's Instructions: Indicate installation procedures that ensure acceptable workmanship and installation standards will be achieved.
- D. Installation Graphic Details.

1.6 QUALITY ASSURANCE

- A. All insulation materials, finishes, coatings, cements, jackets and other insulation accessories shall have minimum composite or individual fire hazard ratings as well as thickness and "C" values conforming to State Building Codes which control building construction materials that may be used on this project. Where specification requirements exceed the Code requirements, the specification shall govern.
- B. Piping insulation for the various piping systems and associated equipment shall be composed of materials which are non-combustible and/or provide a fire resistive system of insulation which complies with the applicable Code having jurisdiction. Generally, it is required that fire hazard ratings shall not exceed the following, except as noted:
 - 1. Flame Spread Rating 25 (No Exceptions)
 - 2. Smoke Developed Rating: 50
- C. All fire hazard ratings shall be as determined by NFPA 255 "Method of Test of Surface Burning Characteristics of Building Materials", ASTM E84 or UL 723.
- D. All insulation materials herein specified shall be used subject to the manufacturer's temperature limitations and their compatibility with other materials.
- E. Installation of all insulation work shall be executed by a qualified Insulation Contractor who is thoroughly experienced in this particular type of work and who has adequate facilities and equipment for installation of all insulation work herein specified and who is familiar with the requirements of the Code enforcing Authorities as to fire hazard rating.
- F. The finished installation shall present a neat and workmanlike appearance with all jackets smooth, with all vapor barriers sealed and intact.
- G. Where insulation is specified for piping, insulate similarly all connections, vents, drains and any piping connected to system subject to heat loss or gain. Do not cover vent petcocks, cleanouts or other maintenance points on equipment unless identified on the insulation with removable access panels or covers.

- H. All chilled water system piping, components and accessories are to be insulated in a manner so as to provide a complete, uninterrupted vapor barrier.

1.7 REGULATORY REQUIREMENTS

- A. Conform to maximum flame spread/smoke developed rating of 25/50 in accordance with ASTM E 84, NFPA 255, or UL 723.

1.8 DELIVERY, STORAGE AND PROTECTION

- A. Accept materials on site, labeled with manufacturer's identification, product density and thickness.
- B. All materials shall be stored in a dry area free from moisture and debris.

1.9 ENVIRONMENTAL REQUIREMENTS

- A. Maintain ambient conditions required by manufacturers of each product.
- B. Maintain temperature before, during and after installation for minimum of 24 hours.

PART 2 – PRODUCTS

2.1 MANUFACTURERS ACCEPTABLE FOR PRODUCT TYPES INDICATED CONTINGENT UPON PRODUCTS' COMPLIANCE WITH THE SPECIFICATIONS

- A. Insulation:
 - 1. Manville Corporation.
 - 2. Owens-Corning Fiberglass Corporation.
 - 3. Certainteed Corporation.
 - 4. Knauf
 - 5. Dow Chemical
- B. Mastics and adhesives:
 - 1. Childers Products Company.
 - 2. H. B. Fuller Company, Foster Products Division.
 - 3. 3M Company Adhesives, Coatings and Sealers.
 - 4. Ruston Plant.
 - 5. Chicago-Mastic
 - 6. Insul-Coustic
 - 7. St. Clair Rubber

8. Vimasco
9. Baldwin-Ehret-Hill

C. Pipe insulation of hanger and support:

1. Pipe Shields, Inc.
2. Rilco Manufacturing Company.
3. Elcen Metal Products Company.
4. Power Piping Company.
5. NPS Industries.

D. PVC fitting covers:

1. Manville, Corporation.
2. Ceel-Co.
3. Certainteed, Corp.
4. Cell Co. Plastics

2.2 GENERAL

- A. Adhesives and insulation materials: Composite fire and smoke hazard ratings maximum 25 for flame spread and 50 for smoke developed for pipe insulation. Adhesives to be waterproof when cured.
- B. The installation of thermal insulating materials coverings and coatings containing asbestos fibers is forbidden.
- C. Insulation shall not be chemically reactive to the metal over which it is applied. Insulation installed on steel shall be neutral or slightly alkaline. Insulation installed on aluminum shall be neutral or slightly acidic.

2.3 MATERIALS AND COMPONENTS

A. Fiberglass insulation:

1. Premolded pipe fiberglass: Recommended temperature to 850 degrees Fahrenheit with facing. Molded in one piece split or hinged circular sections in three foot lengths for piping and tubing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 4.0 pounds per cubic foot and a K value of 0.23 at 75 degrees Fahrenheit mean temperature. Insulation furnished with facing as specified below and as indicated in insulation schedule. Insulation similar to Owens-Corning Type SSL-II. Pressure sensitive tapes using rubber based or acrylic based adhesives are not permitted.
 - a. Insulation of this type for copper piping shall be molded to separate dimensional standards than those used for IPS steel lines.

2. Pipe and tank fiberglass: Recommended temperature to 450 degrees F with facing. Insulation shall be made from long, fine, glass fibers bonded together with a thermosetting resin. Insulation shall have a minimum density of 3 pounds per cubic foot and a k-value of 0.27 btu in/(Hr sq.ft. degree F) at 75 degrees F main temperature. Insulation furnished with facing as specified below and as indicated in insulation schedule. Insulation similar to Manville pipe and tank insulation. Pressure sensitive tapes using rubber based or acrylic based adhesives are not permitted.
3. Flexible fiberglass: Recommended temperature to 250 degrees Fahrenheit. Glass fibrous flexible blanket insulation having density of 0.75 pounds per cubic foot and a K value of 0.30 at 75 degrees mean temperature. Insulation furnished with facing as specified below and indicated in insulation schedule. Insulation and jacket similar to Owens-Corning Type SSL-II.
4. Use pipe and tank fiberglass only when premolded pipe fiberglass is not available. Pipe and tank insulation shall not be used on pipe sizes 24 inches and smaller.

B. Hydrous Calcium Silicate Pipe Insulation

1. Molded, rigid, asbestos free, hydrous calcium silicate water resistant pipe insulation shall be Owens-Corning Fiberglas Kaylo 10 or Manville Thermo-12, molded to dimensional standards conforming to the pipe. Insulation shall have an approximate density of 11 lbs./cu.ft., an approximate thermal conductivity of 0.41 at 200°F mean temperature and shall be suitable for application on surfaces which reach 1200°F. Additional jacket, as hereinafter specified, shall be applied in the field. This material shall be used in finished and concealed areas. In all areas, insulation shall have all joints made with an approved insulation cement to prevent heat leakage through joints. Insulation shall be secured by wire on 9 inch centers.
2. Valves, flanges and fittings occurring in lines insulated with calcium silicate insulation shall be covered with fabricated, mitered segments of molded calcium silicate of thickness equal to insulation on adjacent pipe, wired in place and made smooth with a thin coat of insulating cement. Fittings on pipes 2 inches and smaller may be insulated with insulating cement to a thickness equal to that of adjacent pipe insulation. All fittings shall be finished with glass fabric embedded in fire retardant adhesive.

C. Molded Closed Cell Foam

1. Molded closed cell foam insulation shall be Armacell Armaflex 2000, self-seal white, flexible foam elastomeric thermal insulation of expanded closed cell structure. Insulation shall be rated for 200°F and thermal conductivity of 0.27 per inch thickness at 75°F mean temperature.

D. Chilled Water Piping

1. Option #1: Rigid Polyisocyanurate
 - a. Rigid Polyisocyanurate Insulation fabricated to shape from bun stock.
 - 1) DOW TRYMER* 2000 Rigid Polyisocyanurate Insulation

- b. Product Testing:
 - 1) Product meets the requirements of ASTM C591, type I (TRYMER 2000 brand insulation) except as noted below.
 - 2) Product has a thermal Conductivity of 0.19 btu-in/hr-ft²-°F or lower at 75°F and 180 days aging.
 - 3) Product shall have a flame spread/smoke generation performance tested via method ASTM E-84, UL 723, or NFPA 255 of 25/50 or better at thicknesses of 1.5 inches or less. Flame spread/smoke generation performance of the insulation product shall be established through the presence of a third party certification and listing program involving product testing and periodic follow-up inspections.

- c. For pipe service temperatures below ambient, a vapor retarder is required. For pipe service temperatures above ambient (60°F), a vapor retarder shall not be used and a protective jacketing shall be used. Vapor retarder shall be Saran* Vapor Retarder Film.
 - 1) Proprietary Products: Saran Vapor Retarder in the form of either film or adhesive tape.
 - a) Saran 520 Vapor Retarder Tape
 - 2) Product Testing:
 - a) Saran 540 Vapor Retarder Film
 - (1) Film Thickness: 4 mils +/- 20%
 - (2) Maximum film permeance: 0.03 perms
 - (3) Color: White
 - b) Allowable Temperature Exposure After Installation
 - (1) Saran Film and Saran Tape can be exposed to ambient temperatures ranging from -40°F to +250°F
 - (2) Allowable Installation Temperatures
 - (a) Saran Film can be installed at ambient temperatures ranging from -40°F to +250°F. However, for maximum film flexibility, the film products should be installed at ambient temperatures above 24°F.
 - (b) Saran Tape can be installed at ambient temperatures ranging from 0°F to +150°F.

- d. Protective Jacketing is required in indoor below ambient services and shall be required in indoor, above ambient services. Protective Jacketing is required in all outdoor installations.
 - 1) Indoor Applications: Protective jacketing shall be 20 mil. PVC (adj-4).
 - 2) Outdoor Applications: Jacketing shall be aluminum 0.020" thick with 3 mil. polykraft moisture barrier on the inner side (adj-3b).

- 2. Option #2: Wicking Type Molded Fibrous Glass
 - a. Molded fibrous glass pipe insulation shall comply with the requirements of ASTM C 547 and meet ASTM C 585 for sizes required in the particular system. It shall be of a wicking type suitable for installation on chilled water piping systems. Product shall include a factory applied integral vapor retarded extending under the evaporator area of the wick and covering not less than 98% of the circumference of the product. Exposed evaporator are shall be not less than 0.1 sq. ft./linear ft. or product.
 - 1) Acceptable Manufactures:
 - 2) Owens Corning VaporWick® Pipe Insulation.

 - b. Fittings and valves shall be insulated per manufacturer's instructions:
 - 1) Fittings and valves shall be wrapped continuously with wicking material prior to installing insulation to ensure a continuous path for removal of condensation.
 - 2) Standard PVC fittings with molded/ preformed fiberglass fittings shall be provided.

 - c. All piping shall be supported in such a manner that the insulation is not compromised by the hanger or the effects of the hanger. In all cases, hanger spacing shall be such that the circumferential joint may be made outside the hanger. Cover the evaporating holes with contractor supplied VaporWick Sealing Tape for the length of the metal saddle.

 - d. Accessory materials installed as part of insulation work under this section shall include (but not be limited to):
 - 1) VaporWick® wick material for wrapping valves and fittings
 - 2) Closure Materials - VaporWick® Sealing Tape, and mastics.
 - 3) Support Materials – Hanger straps, hanger rods, saddles, support high-density blocks, and support rings.

E. Equipment insulation:

1. Rigid fiberglass: Recommended temperature to 450 degrees F. Fiberglass rigid board having a density of 3.0 pounds per cubic foot and a K value of 0.23 at 75 degrees F mean temperature. See schedule for facing type.
2. Flexible fiberglass: Recommended temperature to 250 degrees F with facing. Glass fibrous flexible blanket insulation having a density of 0.75 pounds per cubic foot and a K value of 0.30 at 75 degrees F mean temperature.
3. Rigid fiberglass high temperature: Recommended temperature to 850 degrees Fahrenheit. Fiberglass high temperature board having a density of 3 pounds per cubic foot and a K value of 0.30 at 200 degrees Fahrenheit mean temperature.

F. Insulation facing:

1. Code ASJ: All service jacket composed of high intensity white chemically treated Kraft paper reinforced with fiberglass yarn and mesh and laminated to aluminum foil with a fire retardant adhesive. Longitudinal laps and butt strips shall be a minimum of 3 inches.
2. Code FSKL: 0.35 mil aluminum foil reinforced with fiberglass yarn reinforcing scrim and laminated to chemically treated fire resistive Kraft paper having a minimum 35 pound per inch width tensile strength when tested in accordance with ASTM D 828. Water vapor permeability 0.04 perms. Longitudinal laps and butt strips shall be a minimum of 3 inches.

G. Additional insulation jacket:

1. ADJ-3b: 0.020 inch thick aluminum jacket conforming to ASTM B-209 with a 3 mil factory applied polykraft moisture barrier. Longitudinal joints shall be placed at the side of the pipe facing downward at either the 4 o'clock or 8 o'clock position so as to shed water. Aluminum fitting covers, two piece elbows, tees, valve and flange covers, etc., with a 3 mil polykraft or acrylic vapor barrier.
2. ADJ-4: 20 mil PVC jacket suitable for all types of paint. Similar to Manville Zeston 25/50.
3. ADJ-6 A finish jacket of an Asbestos-free and woven as high temperature, heat-resistant fabric. Lagging Cloth having a treated weight of 24 oz./sq.yd. Material shall be suitable for a sustained operation at 1100°F. Calcium silicate piping for generator exhaust piping shall also be jacketed with corrugated aluminum.

H. Adhesives:

1. Code ADH-1: Fibrous adhesive, non-flammable, quick setting adhesive for calcium silicate. Similar to Childers CP-97, 98.
2. Code ADH-2: Fast-drying vinyl base coating and lagging adhesive. Similar to Childers CP-50A HV2.
3. Code ADH-3: Fast-drying neoprene base adhesive for lap joints of foil-faced facing applied over pipe insulation. Similar to Childers CP-82.

4. Code ADH-4: Adhesive for use in adhering fiberglass board or blanket insulation to pipe and equipment. 3M Company Insulation Adhesive No. 35 or 38 non-flammable adhesive.
- I. Caulking components:
1. Code CC-1: For use with foam glass and/or joint sealant applications. Flexible elastomeric vapor barrier sealant. Similar to Childers CP-76.
- J. Mastics:
1. Code MAS-1: Vapor barrier mastic made with an elastomeric resin. For indoor use. Similar to Childers CP-30.
 2. Code MAS-2: A non-water vapor barrier asphaltic emulsion coating, breathing type, for above ground installations. Similar to Childers CP-10.
 3. Code MAS-3: Vapor barrier mastic made with an elastomeric resin. For outdoor use.
- K. Tie wire:
1. Tie wire for securing insulation in place shall be type 304 stainless steel annealed steel wire of gauge and proper spacing as recommended by the insulation manufacturer. Wire shall be drawn up tightly enough to become embedded in the insulation and the ends of the loop twisted, bent over, and pressed into the insulation so as to leave no ends protruding.
- L. Banding:
1. 3/8 inch x 0.02 inch type 304 stainless steel for pipe insulation.
 2. 3/4 inch x 0.02 inch type 304 stainless steel for additional insulation jackets.
- M. Wire mesh:
1. Wire mesh shall be one inch by No. 20 BGW hexagonal mesh galvanized.
 2. Expanded metal: Expanded metal shall be 1/2 inch Hi-Rib metal lath of copper bearing steel.
- N. Tape:
1. Lead foil tape shall be 3M Company Lead Foil Tape No. 422, 4 mil thick, acrylic adhesive, 2 inch wide.
 2. Vinyl plastic tape, silver gray, flame resistant, vapor barrier sealant tape on rigid and flexible insulation material for warm or cold air ducts. Similar to 3M Company Duct Sealing Tape No. 474.
 3. Aluminum foil tape, dead soft aluminum foil, point seal on stick pin, metal patching, moisture barrier, heat reflecting and general sealing on aluminum facing foil. Similar to 3M Company Aluminum Foil Tape No. 425.

- O. Staples:
 - 1. Staples shall be 304 or 316 S.S. outward clinching insulation staples.
- P. Insulating cement:
 - 1. Insulating cement shall be a mineral-fiber (wool) ASTM C 195 base material having essentially the same insulating characteristics as the adjacent insulation. Similar to PABCO High Temperature Insulating Cement. Insulating cement shall be applied in layers to a maximum thickness of 1/2 inch at one time. Each layer shall be allowed to dry thoroughly before subsequent layers are applied.
- Q. Finishing cement:
 - 1. Finishing cement ASTM C 449 shall be diatomaceous silica thermal insulating materials with a suitable proportion of heat resistant binder, hydraulic setting insulating cement capable of withstanding maximum temperature of 700 degrees Fahrenheit. When mixed with water it shall be a plastic mix suitable for trowel applications and shall present a hard, smooth and durable surface after drying. Similar to PABCO No. 127.
- R. Combination insulating and finishing cement:
 - 1. Similar to Ryder One Coat or equal.
- S. Welding studs:
 - 1. Welding studs shall be capacitor type split pin or TCP tipped insulation pins with speed clips. Similar to Nelson Stud Welding Spec. 28.

PART 3 – EXECUTION

3.1 PREPARATION

- A. No insulation shall be applied until the surfaces of the equipment to be insulated are thoroughly cleaned and until pipes and equipment to be insulated have been leak tested and proven tight and accepted by THE ENGINEER
- B. Insulation shall not be applied to piping or equipment until authorization is given to the Contractor by THE ENGINEER. Contractor shall submit a request for authorization. If any insulation is applied without first obtaining authorization, it will be the Contractor's responsibility to remove the insulation and apply it again if so directed.
- C. Ensure surface is clean and dry prior to installation. Ensure insulation is dry before and during application. Finish with systems at operating conditions.

- D. The execution of the insulation work shall be in strict accordance with the best practices of the trade and with the specifications.
- E. The insulation shall be handled and applied in a manner that will not adversely affect its structural or insulating properties.
- F. The installation instructions provided by the insulation material manufacturer of all materials specified in this Section shall be followed when installing these materials. Where the specifications are in conflict with manufacturers' instructions, such conflicts shall be brought to the attention of the ENGINEER for a decision.
- G. Welding operations will not be permitted on certain specific items of equipment, piping and components for the application of studs, pins, support rings, angles, etc. Contractor shall obtain permission in writing from THE ENGINEER to perform any welding.
- H. Coat to seal all insulating cement and calcium silicate surfaces with primer similar to Childers CP-53 or equal before applying any mastic coating.

3.2 PIPING INSULATION INSTALLATION

- A. Ensure insulation is continuous through interior walls. Pack around pipes with fire proof self-supporting insulation material, fully sealed. Insulation on all cold surfaces where vapor barrier jackets are specified must be applied with a continuous, unbroken vapor seal. Hangers, supports, anchors, and other heat conductive parts that are secured directly to cold surfaces must be adequately insulated and vapor sealed to prevent condensation.
- B. Insulate fittings, valves, unions, flanges, and strainers. Do not insulate flexible connections and expansion joints. Terminate insulation neatly with PVC or aluminum end caps.
- C. Premolded fiberglass insulation for straight pipes shall be applied, neatly fitted around piping and sealed with adhesive ADH-3. Adhesive shall be applied to only one side of each joint and shall not be applied to the pipe surface.
- D. Where two sections of pipe insulation butt together provide a 3 inch wide butt strip of same facing material as adjacent insulation facing. Adhere neatly in place using adhesive ADH-3.
- E. All pipe elbows shall be insulated with short radial and mitered pieces of board or block insulation or premolded pieces of pipe insulation. Each piece shall be butted tightly against the adjoining piece and all joints, seams, voids and irregular surfaces shall be filled with insulating cement finished to a smooth, hard and uniform contour. Coat with MAS-1 mastic and reinforce with ADJ-2 additional jacket. In addition, place a fitted PVC cover (ADJ-4) over insulated elbow exception. Tape elbow to adjoining insulation.
- F. All valves and fittings shall be insulated with premolded fittings, sectional pipe insulation, or blocks of the same material and thickness as used for the adjacent pipe. Flange insulation shall overlap the adjoining pipe insulation by not less than the thickness of the pipe insulation.

Sectional pipe covering or block insulation shall be cut to fit, and each section butted closely to the next and held in place with tie wire.

- G. Fittings on pipe lines in finished and concealed areas shall be covered with premolded fiberglass pipe fitting insulators Insul-Coustic or equal, where sizes are available, otherwise, use mitercut segments of molded pipe insulation, wire in place with joints and raw edges sealed with adhesive and smoothed out with a coat of insulating cement.
- H. On cold pipes the fittings shall be finished with (2) coats of an approved vapor barrier mastic, reinforced with glass cloth extending 2 inches onto adjacent pipe insulation. Hot pipes shall be finished in a similar manner except the mastic need not be of the vapor barrier type.
- I. Insulation shall cover the entire surface of the fittings and bodies of the valves up to and including the bonnets, and to the valve stuffing box studs, bolts, or nuts. All joints, seams, and irregular surfaces shall be filled with insulating cement. The insulated surfaces shall be covered with a 1/4 inch thick layer of finishing cement and heavily coated with vapor barrier mastic MAS-1 for cold services and mastic MAS-2 for hot services and reinforced with ADJ-2 additional jacket. Mastic shall be trowelled to a smooth and well-shaped contour compatible with adjoining pipe insulation jackets as specified.
- J. Use ADJ-4 covers over fittings and flanges everywhere except when ADJ-3b is specified.
- K. Repair separation of joints or cracking of insulation due to thermal movement or poor workmanship on all joints of all piping.
- L. All instrument connections for thermometers, thermocouples, gauges, test connections, flow meters, etc., on insulated pipes, vessels, or equipment shall be insulated. The insulation shall be shaped at these connections by tapering it to and around the connection with insulating cement and finishing with finishing cement, vapor barrier adhesive, applicable mastic, or caulking compound.
- M. Where removable flange and valve insulation is required or specified, installation shall conform to the following:
 - 1. Removable flange insulation shall be made from sectional pipe insulation of the same thickness as that on the adjoining pipe or from block insulation 1/2 inch thinner than the pipe insulation and finished with insulating cement. Insulation jackets shall be the same as adjoining pipe insulation unless indicated otherwise.
 - 2. When flange covers are made from sectional pipe insulation, they shall enclose the flanges and be long enough to extend at least 2 inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement. Secure the flange cover in place with stainless steel banding.
 - 3. When flange covers are made from block insulation, they shall be made in two halves. Each half shall consist of mitered blocks wired to 1/2 inch galvanized hardware cloth mesh. This wire frame, with its attached insulation, shall then be secured to the flanges with tie wire. The insulation cover shall be long enough to extend at least 2

inches over the adjacent pipe insulation on each side of the flange. The space between the flange cover and the pipe insulation shall be filled with insulating cement.

The whole flange cover assembly shall be finished with 1/2 inch of insulating cement applied in two coats. After the first coat is dry, the second coat shall be trowelled to a smooth hard finish. All surfaces shall then be finished with jackets as specified in the schedule.

4. Removable valve insulation covers shall be constructed in the same manner as for flanges with the following exception; the two part section shall be divided on the vertical center line of the valve body, bonnet, flange or joint.
5. When specified to insulate the complete valve, the hand wheel or lug wrench shall be removed to accommodate the valve bonnet box. The valve bonnet box shall be constructed in a one piece closure, one end closed, one end opened to fit up to the valve body insulation. Securing the valve and bonnet box sections, sealing and pointing of the insulation shall be done in same manner as specified for flange covers.
6. Unless indicated as removable, a permanent installation as previously specified shall be used.
7. Protect insulation on piping 2 1/2" and up where supported in hangers by means of calcium silicate rigid pipe insulation or jackets. Saddles or shaped galvanized steel pieces approximately 10" long by half the circumferences of insulated pipe.
8. All piping shall have been tested and approved prior to installation of insulation.
9. All piping or surfaces where subject to condensation on the outside shall be insulated including vaporseal finish.

PART 4 – SCHEDULES

4.1 PIPING INSULATED SCHEDULE: (ASJ = "All-Service-Jacket")

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket
MPS Steam (Option #1) Up to 2" 2 1/2" to 6" 8" to 16" 18" & Up	Molded Fiberglass 2 2 1/2 3 3 1/2		ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows
MPS Steam (Option #2) Up to 2" 2 1/2" to 4" 5" to 16" 18" & Up	Hydrous Calcium Silicate 2 1/2 3 3 1/2 5		ADJ-6 ADJ-6 ADJ-6 ADJ-6
LPS Steam Up to 2" 2 1/2" to 6" 6" & Up	Molded Fiber Glass 1 1/2 2 3 1/2	ASJ ASJ ASJ	ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows

Service	Type Insulation and Thickness (Inches)	Facing	Additional Jacket
Hot Water Heating & Condensate Water Up to 2" 2 1/2" & Up	Molded Fiber Glass 1 1/2 2	ASJ ASJ	ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows
Chilled Water (Option #1) Up to 2" 2-1/2" & Up	Rigid Polyisocyanurate 1-1/4" 1-1/2"	4 mil Saran Vapor Retarder	ADJ-4 @ Fittings & Elbows (ADJ-3b for outdoor installation)
Chilled Water (Option #2) Up to 2" 2-1/2" & Up	Wicking Type Molded Fiber Glass 1-1/2 2	ASJ ASJ	ADJ-3b for outdoor installation
Condenser Water	Molded Fiber Glass 1-1/2"	ASJ	ADJ-4 @ Fittings & Elbows
Condensation Drains & Vents, Cold Water Make-up	Molded Fiber Glass 1	ASJ	ADJ-4 @ Fittings & Elbows
Blowdowns (All Pressures) 1/2" to 2" 2 1/2" & Up	Molded Fiber Glass 1 1 1/2	ASJ ASJ	ADJ-4 @ Fittings & Elbows ADJ-4 @ Fittings & Elbows
Refrigerant Piping	Molded Closed Cell Foam 1/2	---	---
Piping with Heat Trace	Molded Fiber Glass 3	ASJ	ADJ-3b
All outdoor piping	Two times thickness scheduled for indoor piping except heat traced		ADJ-3b
MRI Quench Vent	Hydrous Calcium Silicate 2	ADJ-6	ADJ-3b
All pipe within mechanical equipment room	As scheduled		ADJ-4 @ Fittings & Elbows
Others not scheduled	Molded Fiber Glass 1	ASJ	ADJ-4 @ Fittings & Elbows

1. Refer to jacket specifications for finish covering to be installed on calcium silicate insulation in finished areas.
2. Where "Finishing Cement" finishes are scheduled, refer to specifications for Cement herein for materials, method of application, thickness, etc.
3. Provide vapor barrier on all cold water and rainwater piping.
4. Piping exposed to weather shall be insulated with pipe insulation using double the thicknesses scheduled hereinbefore, up to 24 inches beyond the point where pipes enter the building. Provide weatherproof jacket as hereinafter specified.

5. Equipment drains and floor drains from cooling coils as well as drinking fountain waste shall be insulated 6 feet downstream from connection point.

END OF SECTION