

## SECTION 20 07 13

### PLUMBING AND HVAC INSULATION

#### **PART 1 GENERAL**

##### **1.01 SECTION INCLUDES**

- A. Piping insulation
- B. Duct insulation
- C. Equipment insulation
- D. Insulation finishes
- E. Adhesive coatings and sealing compounds
- F. Protection shields
- G. Insulation inserts
- H. Fasteners

##### **1.02 RELATED SECTIONS**

- A. Section 09 91 00 – Painting
- B. Section 20 10 13 – Common Materials and Method for Facility Services

##### **1.03 MEASUREMENT AND PAYMENT**

- A. General: Separate measurement or payment will not be made for the work required under this Section. All costs in connection with the Work specified herein will be considered to be included or incidental to the Work of this Contract.

##### **1.04 REFERENCES**

- A. American Society for Testing and Materials (ASTM):
  - 1. ASTM B209 Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate
  - 2. ASTM C195 Standard Specification for Mineral Fiber Thermal Insulating Cement

3. ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
4. ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation
5. ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
6. ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
7. ASTM C921 Standard Practice for Determining the Property of Jacketing Material for Thermal Insulation
8. ASTM D774 Test Method for Bursting Strength of Paper
9. ASTM D828 Test Method for Tensile Properties of Paper and Paperboard Using Constant-Rate-of-Elongation Apparatus
10. ASTM E84 Test Method for Surface Burning Characteristics of Building Materials
11. ASTM E96 Test Methods for Water Vapor Transmission of Materials

B. Federal Specifications (FS):

1. FS L-P-535 Plastic Sheet (Sheeting): Plastic Strip: Poly(Vinyl Chloride) and Poly(Vinyl Chloride-Vinyl Acetate), Rigid
2. FS HH-B-100 Barrier Material Vapor (for Pipe, Duct and Equipment Thermal, Insulation)
3. FS HH-I-558 Insulation, Blocks, Boards, Blankets, Felts, Sleeving (Pipe and Tube Covering), and Pipe Fitting Covering Thermal (Mineral Fiber, Industrial Type)
4. FS SS-C-540 Coal Tar (Cutback) Roof Coating, Brushing Consistency
5. FS WW-H-171 Hangers and Supports, Pipe

C. Department of Defense, Military Specifications (MIL):

1. MIL-A-3316 Adhesives, Fire-Resistant, Thermal Insulation
2. MIL-C-18480 Coating Compound, Bituminous, Solvent, Coal-Tar Base

- 3. MIL-C-19565 Coating Compounds, Thermal Insulation, Fire- and Water-Resistant, Vapor-Barrier
  - 4. MIL-C-20079 Cloth, Glass; Tape, Textile Glass; Thread, Glass and Wire-Reinforced Glass
  - 5. MIL-I-47049 Insulation Tubing, Silicone Rubber, Heat Shrinkable
- D. Underwriters Laboratories Inc. (UL):
- 1. UL 723 Test for Surface Burning Characteristics of Building Materials
- E. NAIMA National Insulation Standard
- F. NFPA 255 Standard Method of Test Surface Burning Characteristics of Building Material
- G. California Code of Regulations and Energy Conservation Standards California Mechanical Code.

**1.05 SUBMITTALS**

- A. General: Refer to Section 01 33 00, Submittal Procedures, and Section 01 33 23, Shop Drawings, Product Data, and Samples, for submittal requirements and procedures.
- B. Product Data: Submit manufacturer's product data showing and describing the specified products.
- C. Certificates of Compliance: Submit certificates of compliance with specified requirements for proposed products.

**1.06 QUALITY ASSURANCE**

- A. Provide satisfactory test results from National Bureau of Standards, or satisfactory certified test report from an accepted testing laboratory, indicating that fire hazard ratings for products proposed for use do not exceed those specified.
- B. Products or their shipping cartons shall bear a label indicating that the fire and smoke hazard ratings are as specified.
- C. Provide fire resistance values as follows:
  - 1. All components of insulation for piping, ductwork, and equipment, except unicellular insulation, canvas and flexible tubing, including coverings, mastics,

and adhesives, shall have fire hazard classification with flame spread/fuel contributed/smoke developed rating of 25/50/50 in accordance with ASTM E84, NPFA 225 and UL 723, as applicable.

2. Provide materials listed in UL Building Materials Directory under heading Hazard Classification (Fire), or tested by accepted testing laboratory in accordance with UL criteria.
3. Test materials that are factory applied and assembled. Test materials that are field applied individually.
4. Do not employ fungicide or corrosive treatment to impart flame resistance. Flame proofing treatments subject to deterioration due to effects of moisture and high humidity are not acceptable.

**PART 2 PRODUCTS**

**2.01 PIPING INSULATION**

- A. Provide piping insulation in accordance with the requirements of ASTM C547 and Table 1 below. Insulate fittings, flanges, and valves (except valve stems, handwheels, and operators) with pre-molded, either precut or job fabricated, insulation of equivalent thickness and of same composition as insulation installed on adjacent piping. Thickness of insulation shall be in accordance with applicable requirements of the California Energy Code, unless otherwise indicated.
- B. Restrict use of unicellular insulation to run outs serving individual terminal units not to exceed 12 feet in length, piping on packaged equipment, and piping exterior to a building.
- C. Provide vapor barrier jackets, factory-applied, on pipe insulation except on hot water lines insulation, or unicellular insulation.

**Table 1 - Insulation Material for Piping**

<u>Service</u>	<u>Materials</u> <u>All Services</u>	<u>Specification</u>	<u>Type</u>	<u>Grade/ Class</u>
Domestic hot water	Mineral	FS HH-I-558	DIII	12
Electric water cooler drain	Mineral fiber	FS HH-I-558	DIII	12
Air conditioner interior condensate drain piping	Mineral fiber	FS HH-I-558	DIII	12
Refrigerant suction	Uni-cellular	MIL-I-47049		

tubular line

Diesel engine exhaust                      Calcium silicate                      ASTM C533

**2.02            DUCT INSULATION**

- A.     Provide fibrous glass air-conditioning and heating duct insulation conforming to ASTM C612, Class 1, of ten pound per cubic foot density for rigid insulation, and conforming to ASTM C553, Type I, Class B-4, of 1.5 pounds per cubic foot density for flexible connections. Insulation for air conditioning ducts shall be provided with 0.002 inch foil scrim facing.
  
- B.     Duct insulation shall meet all requirements of California Mechanical Code, including insulation thickness. No insulation or sound proofing is allowed to be installed inside the supply and return air ducts. Apply insulation in accordance with the following requirements:

**Table 2 - Insulation Material for Ductwork**

<u>Ductwork</u>	<u>Material</u>	<u>Type</u>	<u>Specification</u>	<u>Class</u>
Outside air intake duct	Glass fiber	Rigid	ASTM C612	1
Outside air-conditioned air plenums	Glass fiber	Rigid	ASTM C612	1
Conditioned air supply ducts exposed to outside air	Glass fiber	Rigid	ASTM C612	1
Conditioned air supply ducts from fans to vertical ducts in shafts	Glass fiber	Rigid	ASTM C612	1
Conditioned air supply ducts, vertical shafts	Glass fiber	Rigid	ASTM C612	1
Conditioned air supply ducts concealed	Glass fiber	Flexible	ASTM C553	Commer
Conditioned air supply ducts, exposed	Glass fiber	Rigid	ASTM C612	1
Conditioned air in mechanical equipment room	Glass fiber	Rigid	ASTM C612	1
Conditioned air return ducts in spaces not air conditioned or heated	Glass fiber	Rigid	ASTM C612	1

**2.03 EQUIPMENT INSULATION**

- A. Provide rigid fiberglass insulation, 2 inches thick, conforming to ASTM C612, Class 1, of 10 pounds per cubic foot density.
- B. The following equipment shall be insulated:
  - 1. Drip pan under chilled equipment.
  - 2. Roof drain bodies.

**2.04 INSULATION FINISHES**

- A. Provide vapor barrier jackets for piping, ducts and equipment insulation conforming to FS HH-B-100, Type I or II for piping and equipment, and Type II for ducts.
- B. Provide pre-sized glass cloth jacket with or without integral vapor barrier. Jacket with integral vapor barrier may be used instead of the vapor barrier specified herein, and with a perm rating as specified in FS HH-B-100, Type I or II for the vapor barrier jacket for the applicable service. Provide glass cloth jackets having a bursting strength of not less than 200 psi in accordance with ASTM D774. Jacket material shall not support fungus growth. Provide factory-applied jackets on the insulation.
- C. Provide all-purpose jacket having a perm rating of not more than 0.02 in accordance with ASTM E96, and a tensile strength of not less than 35 pounds per inch of width in accordance with ASTM D828. Provide factory applied all-purpose jacket material on pipe, equipment, and concealed duct insulation. Provide glass-scrim-reinforced white vinyl finish.
- D. Provide aluminum jacket, 0.016 inch thick in accordance with ASTM B209.

**2.05 ADHESIVE COATINGS AND SEALING COMPOUNDS**

- A. Requirements: Provide adhesive coatings and sealing compounds that are compatible with materials to that they are applied, and that will not corrode, soften, or otherwise attack such material in either wet or dry state.
- B. Adhesives: Conform to the following requirements:
  - 1. Lap Adhesive for Vapor Barrier Jackets: Conform to MIL-A-3316, Class 2.
  - 2. Lagging Adhesive: Conform to MIL-A-3316, Class 1.
  - 3. Insulation Cement: Conform to ASTM C195.

4. Bonding Adhesive: Adhesive for securing insulation to metal surfaces shall be as recommended by the insulation manufacturer.

C. Coating Compounds:

1. Provide coating compound used as a vapor barrier treatment conforming to MIL-C-19565, either Type I or II. Provide white vapor barrier coating where exposed to view.
2. Provide coating compound used as metal protection in accordance with FS SS-C-540, and apply a coal tar base coating conforming to MIL-C-18480.
3. Provide weatherproofing coating compound for protective finish outdoors conforming to MIL-C-19565, Type I.
4. Provide glass tape conforming to MIL-C-20079, Type II, Class I.
5. Provide coating compound used as a vapor barrier for fittings on piping systems above 35 degrees F of polyvinyl chloride conforming to FS L-P-535, Composition A, Type II.

**2.06 PROTECTION SHIELDS**

- A. Provide half round protection shields conforming to FS WW-H-171, Type 41.

**2.07 INSULATION INSERTS**

- A. Provide insulation inserts at pipe hanger supports for pipe 2 inches and larger of either calcium silicate, cellular glass, pre-stressed molded glass fiber of minimum 13-pound density, or other accepted material of the same thickness as adjacent insulation and not less than 13 pound density.

**2.08 FASTENERS**

- A. Provide fasteners of corrosion-resistant material. Provide staples of minimum 3/4 inch width; thickness not less than 0.005 inch for zinc-coated steel and not less than 0.007 inch for aluminum. Provide speed washers and anchor pins as recommended by the manufacturer for type and thickness of insulation specified. Provide bands for metal jackets 3/8 inch wide and 0.015 inch thick of zinc-coated steel or 0.020 inch thick of aluminum.

**PART 3 EXECUTION****3.01 SITE CONDITIONS**

- A. Test, clean, and inspect surfaces and equipment that insulation will be applied or installed before the Work of this Section begins. Provide surfaces acceptable for the application/installation of insulation products.

**3.02 INSTALLATION REQUIREMENTS**

- A. Piping Insulation: Insulate piping systems as listed in Table 1 herein. Insulate fittings, flanges, and valves unless otherwise indicated.
- B. Duct Insulation: Insulate ducts and plenums of heating, ventilating, and air-conditioning systems as listed in Table 2 herein. Do not insulate the following ductwork:
  - 1. Air conditioning return ducts in air-conditioned spaces.
  - 2. Heating return ducts in heated spaces.
  - 3. Duct systems at fire dampers.
  - 4. Ventilation exhaust ducts, except hot exhaust ducts in air conditioned space.
- C. HVAC Spaces Defined: Air conditioned and heated spaces are defined as those spaces directly supplied with heated or cooled air, or provided with a heating or cooling device such as a fan coil unit.
- D. Diesel-Generator Exhaust Pipe Insulation: Diesel engine generator exhaust piping inside building shall be insulated with calcium silicate, as indicated and specified. The stainless steel expansion joint shall be insulated with 100 percent asbestos-free mineral fiber blanket insulation covered with a glass cloth jacket and held in place with stainless steel wire and covered with stainless steel screening. The insulation and screen cover shall not interfere with the movement of the expansion joint.
- E. Insulation Finishes for Piping:
  - 1. Provide factory-applied vapor barrier jackets on pipe insulation if concealed in crawl spaces, pipe chases, tunnels, and trenches. Vapor barrier jackets are not required for unicellular insulation.
  - 2. Provide a factory-applied, all-purpose jacket for pipe insulation in exposed locations, except that which is exposed to the weather and unicellular insulation, either with or without integral vapor barrier.

3. Apply two coats of vinyl lacquer to unicellular insulation exposed to the weather.
4. Finish insulated fittings, flanges and valves as specified in Article 3.02 herein. Finish fittings, flanges, and valves with job fabricated metal covers. Finish elbows and curved piping with factory-fabricated metal covers. Provide covers of the same thickness and material as jackets on adjacent piping. Secure metal covers in place with metal bands, and seal with a waterproof coating.
5. Cover outdoor piping and insulation with aluminum jacket. The jacket shall be held in place by a continuous friction type joint, providing a positive weather seal over the entire length of jacket. The circumferential joints shall be secured with preformed aluminum jackets, two-piece elbows, and flange covers, secured with steel bands.

F. Insulation Finishes for Ducts and Equipment:

1. Provide vapor barrier jacket for insulated equipment. Provide factory-applied vapor barrier jacket for insulated air conditioning ducts.
2. Duct and equipment insulation concealed from view within the building requires no additional finish. Where exposed to the public in buildings, no additional finish is required on plenums, casing, fans, ducts, and equipment insulation where pre-sized glass cloth or all-purpose jacket is the outer surface. Otherwise apply either pre-sized glass cloth or tape embedded in a wet coat of lagging adhesive.
3. Finish plenums, casings, fans, ducts, and equipment insulation exposed to the weather shall cover with vinyl/PVC jacket.

**3.03 INSTALLATION**

- A. Install insulation material having smooth and even surfaces, jackets drawn tight, and smoothly cemented down on longitudinal and end laps. Do not apply insulation materials until all surfaces to be covered are tested for leaks, cleaned and dried, and foreign materials such as rust, scale, and dirt have been removed. Provide clean insulation when installed and during the application of finish. Neatly finish insulation at pipe and duct hangers.
- B. Provide continuous insulation through hangers, sleeves, and wall and ceiling openings, except at fire dampers in duct systems. Insulate piping and ductwork individually.
- C. Where plumbing pipes are located in chases and space does not permit installation of sectional insulation, when approved by the Engineer, pipes may have insulation omitted, provided chases are packed full of mineral fiber or rock wool.

- D. Provide a complete moisture and vapor seal wherever insulation terminates against metal hangers, anchors, and other projections through insulation on cold surfaces for that a vapor seal is specified.
- E. Fill joints, breaks, punctures, and voids with vapor barrier compound, and cover with vapor seal material identical to the surrounding insulation. Seal off ends of pipe insulation with vapor barrier coating at valves, flanges, fittings, and on long runs of pipe at intervals not to exceed 15 feet.
- F. Do not insulate chrome-plated pipes and pipes used solely for fire protection. Omit insulation from vibration isolating connections, but neatly terminate and bevel adjacent insulation. Do not insulate access plates in ducts or plenums for air heating systems.
- G. Install acoustical and internal duct liner as recommended by the material manufacturer and as specified in Article 3.04.

### **3.04 PIPE INSULATION**

- A. Provide sectional pipe insulation (except unicellular insulation) with sections of insulation placed around the pipe and tightly butted into place. Draw jacket laps tight and smooth, and secure with fire-resistant adhesive and non-corrosive outward-clinching staples spaced not over 4 inches on centers and 1 inch from edge of lap.
- B. Cover circumferential joints with butt strips not less than 3 inches wide, of material identical to the jacket material. Provide adhesive used to secure the butt strip that is the same as that used to secure the jacket laps. Apply staples to both edges of the butt strips. Seal staples and seams with a brush coat of fire-resistant vapor barrier coating applied at longitudinal and circumferential laps. Staples may be omitted when factory-applied, self-sealing system is used unless fishmouths develop.
- C. Coat ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints at intervals of not more than 12 feet on continuous runs of pipe with a vapor barrier coating. Patch breaks and punctures in the jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past the break in both directions.
- D. At penetrations, such as at thermometers, fill the voids in the insulation with vapor barrier coating, and seal the penetration with a brush coat of the same coating.
- E. Do not use staples to secure jacket laps on pipes carrying fluid at temperatures below 45 degrees F.

- F. Slip unicellular tubular insulation over the pipe or split and apply around the pipe. Seal butt joints and end of tubing with pressure-sensitive vinyl plastic tape or vapor barrier adhesive. Seal longitudinal joints with vapor barrier adhesive, and secure on 9 inch centers with pressure-sensitive vinyl plastic tape. Vapor barrier jackets are not required for unicellular insulation.
- G. Provide continuous insulation through pipe hangers and pipe sleeves. At hangers where the pipe is supported, provide an insulated protection shield. Provide pipes 2 inches and larger with insulation inserts at points of hanger supports. Provide inserts having sufficient compressive strength to adequately support the pipe without compressing the inserts to a thickness less than the adjacent insulation. Provide inserts that are 180 degrees and not less than the length of the protection shield. Provide vapor barrier facing of the insert of the same material as the facing on the adjacent insulation.
- H. Provide an aluminum jacket over the insulation on pipe passing through sleeves where caulking is required. When penetrating interior walls, extend the aluminum jacket 2 inches out on either side of the wall, and secure on each end with a band. Extend the metal jacket when penetrating floors, from a point below the backup material to a point 10 inches above the floor, with the band at the floor and one not more than 1 inch from end of aluminum jacket.
- I. When segments of insulation are installed, cover flanges, unions, valves, and fittings as herein specified. Provide elbows with not less than three segments. For other fittings and valves, cut to required curvature, or place and join nesting size sectional insulation segments with adhesive. After the segments are in place, apply a vapor barrier coating.
- J. Where unions are indicated not to be insulated, terminate the covering neatly at the end of unions with insulating cement troweled on a bevel. Provide a coat of vapor barrier coating on beveled ends. Insulate anchors the same way as piping for a distance not less than 6 inches from the surface of the pipe insulation. Provide vapor seal insulation for anchors as specified for fittings.

### **3.05 DUCT, PLENUM, AND CASING INSULATION**

- A. Rigid duct insulation shall be secured to ducts by impaling over either pins or anchors located not more than 3 inches from edges of boards and spaced not more than 12 inches on centers. Insulation shall be secured with washers and clips. Pins or anchors shall be connected to duct surfaces with waterproof adhesive especially designed for attachment to metal surfaces. Insulation shall be applied with joints tightly butted.
- B. Insulation shall be installed without sag on underside of ductwork. Adhesive or mechanical fasteners shall be used where necessary to prevent sagging.
- C. Vapor barrier penetrations shall be sealed by mechanical fasteners with vapor barrier adhesive.

- D. Insulation shall be stopped and pointed around access doors and damper operators to allow operation without disturbing wrapping.
- E. Insulation and vapor barrier shall be continuous through wall and floor penetrations.
- F. Thickness of insulation for ductwork shall be as indicated or specified.
- G. Omit insulation on ducts internally lined with acoustical duct liner.

### **3.06 EQUIPMENT**

- A. Insulation shall be applied as close as possible to equipment by grooving, scoring, and beveling insulation, if necessary. Insulation shall be secured to equipment with studs, pins, clips, adhesive, wires, or bands.
- B. Joints, cracks, seams, and depressions shall be filled with bedding compound to form smooth surface. On cold equipment, vapor barrier cement shall be used.
- C. Insulation shall be covered with metal mesh and finished with heavy coat of insulating cement.
- D. Insulation shall not be applied over nameplate or ASME stamps. Insulation shall be beveled and sealed around such items.
- E. When equipment with insulation requires periodical opening for maintenance, repair, or cleaning, insulation shall be installed in such a manner that it can be easily removed and replaced without damage.

### **3.07 INSULATION FINISH APPLICATION**

- A. Factory-apply vapor barrier jackets for piping and facing for ductwork insulation. At Joints, cover the vapor barrier jacket for rigid insulation with either 4 inch wide, pressure-sensitive vapor seal tape or strips of material identical to jackets, or have 2 inch wide laps drawn tight and secured with vapor seal adhesive.
- B. Secure the tape or laps with flared staples, spaced 4 inches on centers and 1 inch from edges of tape or laps.
- C. Brush coat joints and openings where the facing is pierced or punctured by pins or other means, with 2 inch wide strips of vapor barrier coating compound and vapor seal material to provide a vapor-tight covering.

**3.08 PROTECTION AND REPLACEMENT**

- A. Replace damaged insulation that cannot be repaired to the satisfaction of the Engineer, including units with vapor barrier damage and moisture-saturated units.
- B. Provide protection of the finished work during the remainder of the construction period, to avoid damage and deterioration of the insulation and finish coatings and sealants.

**3.09 PAINTING**

- A. Comply with applicable requirements of Section 09 91 00, Painting. |

**END OF SECTION 20 07 13**