

## SECTION 232500 – HVAC INSULATION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION

- A. General provisions and other HVAC systems are specified in other Sections of Division 23.
- B. This Section covers thermal insulation for equipment, ductwork and piping specified in Division 23.
- C. Items not to be insulated:
  - 1. Piping installed in enclosures for:
    - a. Unit ventilators.
    - b. Unit heaters.
    - c. Finned tube radiation.
- D. This Section includes responsibilities and obligations in support of the performance verification specified in Section 230090, HVAC Performance Verification.

#### 1.2 DEFINITIONS

- A. Exterior piping, ductwork, or equipment is exposed to outdoor temperature.

#### 1.3 QUALITY ASSURANCE

- A. Conform to the following:
  - 1. North Carolina State Energy Conservation Code-2018.
  - 2. North Carolina State Mechanical Code-2018.
- B. Products of the manufacturers listed will be acceptable for use for the specific functions specified herein. Materials shall be compatible with the materials to which they are applied, and shall not corrode, soften or otherwise attack such material in either the wet or dry state.
- C. Materials shall be applied subject to their temperature limits. Methods of application of insulating materials or finishes not specified in detail herein shall be in accordance with the particular manufacturer's published recommendations.
- D. Insulation shall be applied by experienced workers regularly employed for this type of work.

#### 1.4 RATINGS

- A. Insulation and accessories, unless specifically excepted herein, shall have a maximum composite flame spread rating of 25 and a maximum smoke developed rating of 50. Materials that are factory-applied shall be tested as assembled. Materials which are field-applied may be tested individually. No fugitive or corrosive treatments shall be employed to impart flame resistance.
- B. Flame spread and smoke developed ratings shall be in accordance with ASTM E84-2019b. Products or their shipping cartons shall bear a label indicating flame spread and smoke developed ratings.
- C. Treatment of pipe jackets and duct facings to impart flame and smoke safety shall be permanent. The use of water-soluble treatments is prohibited.

- D. Vapor retarders shall have a maximum permeance of 0.02 perm at 73.4°F.

## 1.5 ALTERNATE THICKNESSES

- A. Specified thicknesses may be increased or reduced for insulation materials having thermal resistivity, K-values, different from those listed. Submit calculations in accordance with ASHRAE/IES 90.1-2019, and documentation of product performance.

## PART 2 - PRODUCTS

### 2.1 MATERIALS

A. Fiberglass Pipe, Duct and Equipment Insulation:

1. Maximum K-value for preformed pipe insulation: 0.23 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
2. Maximum K-value for board insulation: 0.23 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
3. Minimum R-value for blanket insulation shall be as specified herein and shall be based on an installed condition with 25% compression of the specified nominal thickness at 75°F.
4. Pipe and board insulation for steam piping and hot water piping, except low temperature hot water, shall have maximum service temperature of 850°F. Insulation for other services shall have maximum service temperature not less than 250°F.
5. Pipe and board insulation for hot equipment shall be designed for operating temperatures up to 850°F.
6. Manufacturer: CertainTeed, Johns Manville, Knauf, Owens Corning, or Manson Insulation.

B. Adhesives, Sealants, Coatings, and Mastics:

1. Vapor barrier mastic (white) for below ambient pipe and duct service only. Water vapor permeance shall comply with ASTM E96/E96M-2016, 0.08 perms or less at 45 mils dry.
  - a. Manufacturer: Childers CP-34, Foster 30-65, or Vimasco 749.
2. Lagging adhesive and coating.
  - a. Manufacturer: Childers Chil-Seal CP-50A MVI, Foster 30-36 Sealfas, or Vimasco 136.
3. Insulation joint sealant for cellular glass, phenolic, and polyisocyanurate.
  - a. Manufacturer: Childers Chil Byl CP-76, Foster Flextra 95-50, or Pittsburgh Corning Pittseal CW.
4. Elastomeric adhesive.
  - a. Manufacturer: Armaflex 520 BLV, Childers CP-82, Foster 85-75, or Kflex 720-LVOC.
5. Elastomeric insulation coating.
  - a. Manufacturer: Armacell WB Finish, or Kflex 374, Killark.
6. Aluminum jacketing sealant, and flexible butyl elastomer based vapor barrier sealant.
  - a. Manufacturer: Childers Chil-ByL CP-76, Foster 95-44, or Pittsburgh Corning PC 444N.

C. Preformed Fittings:

1. Equal thickness and composition to adjacent pipe insulation.
2. Manufacturer: Extol, Performance Insulation Fabricators, or Specialty Products & Insulation.

D. Insulating Cement:

1. Mineral wool type, asbestos free, maximum K-value of 0.20 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
2. Manufacturer: Industrial Insulation Group CalCoat-127, or Ramco Ramcote 1200.

- E. Cellular Glass:
  - 1. Maximum K-value: 0.29 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
  - 2. Manufacturer: Pittsburgh Corning Foamglas.
- F. PVC Fitting Covers:
  - 1. Preformed insulated PVC covers for pipe fittings. Insulation thickness shall match adjacent piping, and shall be increased to limit insulation outer surface temperature to 150°F.
  - 2. Manufacturer: Johns Manville Zeston 2000, Proto Corporation, or Speedline Corporation.
- G. Flexible Elastomeric Sheet, Tubing and Tape:
  - 1. Closed-cell.
  - 2. Maximum K-value: 0.25 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
  - 3. Manufacturer: Aeroflex Aerocel, Armacell AP Armaflex, or K-flex.
- H. Mineral Wool:
  - 1. Maximum K-value: 0.28 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
  - 2. Maximum service temperature: 1200°F.
  - 3. Manufacturer: Fibrex, Johns Manville, Owens Corning, or Rock Wool.
- I. Polyisocyanurate:
  - 1. Maximum aged 180-day K-value: 0.19 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
  - 2. Minimum density: 2 pcf.
  - 3. Manufacturer: Hitherm HT 300, ITW Trymer 25-50 or Knauf Insulation.
- J. Phenolic:
  - 1. Maximum K-value: 0.18 Btu·in/(h·ft<sup>2</sup>·°F) at 75°F.
  - 2. Minimum density: 2.5 pcf.
  - 3. Manufacturer: ITW Trymer Supercel, Resolco International Insul-phen, or Johns Manville.
- K. Glass fabric: 10 x 10 construction white fiberglass scrim fabric.
- L. Tape: pressure sensitive, foil-scrim-kraft backed.
- M. Staples: outward clinching type.
- N. Rigid inserts: cellular glass or 5 pcf phenolic. Rigid inserts shall be same length as insulation protectors, 360° pipe coverage, and same thickness as adjacent insulation. Where polyisocyanurate is specified herein, rigid inserts may be polyisocyanurate, minimum 2 pcf for piping 6" and smaller and minimum 3 pcf for pipe 8" and larger. Where fiberglass is specified herein, rigid inserts may be premolded minimum 20 pcf fiberglass blocks with 180° pipe coverage. Where flexible elastomeric is specified herein, rigid inserts may be rigid foam designed for the supported weight without compression. Provide jacketing, joint sealing, and weatherproofing as specified for the pipe service. Fiberglass inserts shall be selected for a maximum 10% compression when loaded. Polyisocyanurate inserts shall be selected such that compressive load does not exceed 33% of the compressive strength of the insert.

## PART 3 - EXECUTION

### 3.1 GENERAL

- A. Surfaces to be insulated shall be clean, dry, and free of foreign material, rust, scale and dirt when insulation is applied. Perform pressure and leakage tests and submit results required by other Sections before applying insulation.
- B. Where existing insulation is damaged due to the new work, repair damage to match existing work or replace damaged portion with insulation specified for new work.

### 3.2 MATERIAL SELECTIONS

- A. Where multiple insulation materials are specified herein for the same service, one of the specified materials shall be applied and used consistently throughout the project, subject to the requirements of these specifications.

### 3.3 INSULATION FOR COLD PIPE

- A. Insulate the following pipe with preformed phenolic or polyisocyanurate pipe insulation of the thickness indicated with a vapor retarder and all service jacket with self-sealing lap:

	<u>Insulation Thickness, Inches</u>		
	<u>Through 1.25"</u>	<u>1.5" - 12"</u>	<u>14" and over</u>
Chilled water supply and return, except as specified herein	1	1.5	1.5
	0.5	0.5	0.5
Exterior chilled water supply and return	1	1.5	1.5

1. Seal longitudinal and end joints with sealant and mastic as recommended by the manufacturer to achieve the permeance rating specified herein. Install insulation with jacket drawn tight with side-laps and end joint butt strips secured. End joint butt strips shall be same material as jacket, not less than 3" wide.
2. Insulate fittings, flanges, strainers, unions, and valves with preformed or mitered phenolic or polyisocyanurate fitting sections. Secure fittings in place, seal joints and contour mitered sections with insulating cement, and finish with a layer of glass fabric embedded between 2 coats of vapor barrier mastic. Glass fabric shall overlap adjoining insulation at least 2".
3. Where temperature maintenance cable is specified herein or indicated on the Drawings, piping shall be insulated after application of temperature maintenance cable.
4. Provide vapor stops consisting of glass fabric and vapor barrier mastic over the entire end of butt joints at control valves, strainers, and equipment requiring access.

- B. Insulate the following pipe with preformed cellular glass pipe insulation of thickness indicated with a vapor retarder and all service jacket with self-sealing lap:

	<u>Insulation Thickness, Inches</u>	
	<u>Through 1.25"</u>	<u>1.5" and over</u>
Chilled water supply and return, except as specified herein	1.5	2

Insulation Thickness, Inches

Pipe Sizes

Through 1.25"

1.5" and over

Exterior chilled water supply and return

1.5

2

1. Seal longitudinal and end joints with sealant and mastic. Install insulation with jacket drawn tight with side-laps and end joint butt strips secured. End joint butt strips shall be same material as jacket, not less than 3" wide.
2. Insulate fittings, flanges, strainers, unions, and valves with preformed or mitered cellular glass fitting sections. Secure fittings in place, seal joints and contour mitered sections with insulating cement, and finish with a layer of glass fabric embedded between 2 coats of vapor barrier mastic. Glass fabric shall overlap adjoining insulation at least 2".
3. Where temperature maintenance cable is specified herein or indicated on the Drawings, piping shall be insulated after application of temperature maintenance cable.

C. Insulate the following pipe with preformed flexible elastomeric insulation 1.5" thickness:

Refrigerant suction.  
Refrigerant liquid.  
Condensate drain.

1. Insulation shall be slipped on before pipe joints are completed. Hold back from hot joints until cool. Cement insulation joints with adhesive applied to both ends.
2. Insulate fittings, flanges, unions, and valves with fabricated fittings, same thickness as piping.

### 3.4 INSULATION FOR COLD EQUIPMENT

- A. Insulate chilled water pumps with 1" thick flexible elastomeric sheets. Insulation shall be adhered to inside of 18 gauge aluminum casings. Casings shall be fabricated in a minimum of 2 sections, with flanged and bolted joints or operable latches and hinges. Hardware shall be galvanized or cadmium-plated steel. Casings shall be designed for removal to allow access for maintenance without damaging insulation. Seal penetrations of casings.
- B. Insulate chilled water expansion tanks, chilled water buffer tanks, and inline air separators as specified herein for chilled water pipe.
- C. Insulate chilled water piping appurtenances, thermowells, thermometer test wells, gauge cocks, valve stems, and hangers and supports subject to sweating with flexible elastomeric tape.

### 3.5 INSULATION FOR DUCT SYSTEMS

- A. Insulate the following concealed duct systems with flexible, fiberglass insulation, nominal 2.2" thickness, minimum R-value at the installed condition of 6.0 h·ft<sup>2</sup>·°F/Btu, with foil-scrim-kraft facing:

Supply ductwork and plenums.  
Outside air ductwork and plenums.  
Mixed air ductwork and plenums.  
Intake, exhaust and relief plenums.  
Surfaces of diffusers exposed to unconditioned or indirectly conditioned spaces.

1. Overlap edges 3" and secure 12" on center with copper-clad, stainless steel or galvanized steel wire.

2. Seal joints, breaks, and punctures with tape.
  3. On ducts over 24" wide, insulation shall be secured to the underside with mechanical fasteners maximum 18" on center each way.
  4. Insulation shall be installed with 25% or less compression of the nominal thickness.
- B. Insulate the following exposed duct systems with 2" thick rigid fiberglass board, 3pcf minimum density, with foil-scrim-kraft facing:
- Supply ductwork and plenums.
  - Outside air ductwork and plenums.
  - Mixed air ductwork and plenums.
  - Intake, exhaust and relief plenums.
1. Secure with welded pins or clips set in adhesive 18" on center each way with 2 rows per panel minimum.
  2. Seal joints and clips with tape.
  3. Finish insulation with glass fabric, set in white lagging adhesive.

### 3.6 INSTALLATION

- A. Insulation shall be clean and dry during installation and during application of any finish.
- B. Provide removable and replaceable covers on pumps, equipment, and removable ends of strainers requiring insulation that must be opened periodically for inspection, cleaning, or repair.
- C. Install insulation materials with smooth and even surfaces, jackets drawn tight and cemented down smoothly at longitudinal and end laps. Do not use scrap pieces of insulation where a full length section will fit.
- D. Install insulation, jackets and coatings continuous through openings and sleeves in nonrated construction. For penetrations of fire- or smoke-rated construction, insulation shall be butted tightly against firestops specified in Section 230010, HVAC General. Tape and seal butt joints.
- E. Banding wires shall have the twisted terminals turned down toward the insulation without damaging the vapor barrier.
- F. Install layered insulation with layer joints staggered. Wire inner layer 9" on center; apply outer layer and finish as specified herein.
- G. Finish open ends of pipe insulation as specified herein for fittings.
- H. Provide rigid inserts at each insulation protector location for piping 1.5" and larger.
- I. Fill hollow steel pipe covering protection saddles with fiberglass insulation.
- J. Standing seams and projections in ductwork or casings shall have insulation applied so that at least 0.25" of insulation will cover such projections.
- K. Lined Ductwork:
1. Where ductwork and plenums are lined, no external thermal insulation is required
  2. Where lining is interrupted at dampers and heating coils, insulate ductwork.
  3. Where unlined duct and lined duct connect, the insulation shall overlap lined section at least 4".
- L. Insulation and vapor barrier shall be continuous around and under standoff brackets used for mounting balancing and control devices on ductwork.

- M. Where equipment is furnished with other components and adjoining piping factory-assembled on a skid or other common platform, such equipment and piping shall be insulated as specified herein.

3.7 WEATHERPROOFING

- A. Protect insulation on ductwork and equipment exposed to weather outside the building with self-adhering flexible exterior covering. Junctions of horizontal and vertical surfaces shall have a minimum of 3" vertical overlap. Horizontal seams shall have a minimum of 6" overlap in roof shingle fashion. Install as recommended by the manufacturer.
- B. Protect insulation, except flexible elastomeric, on piping exposed to weather outside the building with 0.016" thick corrugated aluminum jacketing with factory-applied moisture retarder protective film on the inner surface. Provide 2" overlap at joints with sealant as recommended by the manufacturer. Locate longitudinal joints to shed water. Secure jacketing with aluminum bands every 12" and at end joints.
- C. Protect exterior flexible elastomeric insulation with UV resistant white acrylic latex coating.

END OF SECTION 232500