

SECTION 23 07 00 - HVAC SYSTEM INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section Includes insulation materials and accessories for insulating HVAC system piping, ductwork, and equipment.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).
- B. Provide detailed shop drawings for the exterior duct insulation system. The shop drawings are to be prepared by the manufacturer / certified installer and shall include warranty information.
- C. Exterior Duct Insulation System: provide Certification the installation contractor is certified by PTM Manufacturing.

1.4 QUALITY ASSURANCE

- A. Duct and pipe insulation, including adhesives, shall have a flame spread index not more than 25 and a smoke-developed index of not more than 50 when tested in accordance with ASTM E 84 or UL 723, using the procedures of ASTM E2231. Duct coverings shall not flame, glow, smolder or smoke when tested in accordance with ASTM C 411 at the temperature to which they are exposed in service. The test temperature shall not fall below 250 degrees F.
- B. All insulation values are to meet the requirements of the applicable edition of the International Energy Conservation Code.
- C. Insulation installed on the exterior of ducts, located within the building, shall bear identification at intervals not greater than 36-inches, with the name of the manufacturer, the R value at the specified installed thickness and the flame spread and smoke developed indexes of the composite materials.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature. Store materials providing protection from the elements.

1.6 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields. Coordinate clearance requirements with the duct and piping.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

- A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials. Insulation conductivity (k) shall not exceed 0.27 Btu per inch/h – ft<sup>2</sup> – deg. F.
  - 1. Products: Subject to compliance with requirements, provide products manufactured by one of the following:
    - a. Armacell LLC; AP Armaflex.
    - b. Aeroflex USA Inc.; Aerocel.
- B. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 1136 with factory-applied FSK jacket. Insulation conductivity (k) shall not exceed 0.27 Btu per inch/h – ft<sup>2</sup> – deg. F.
  - 1. Products: Subject to compliance with requirements, provide Johns Manville Microlite insulation or equal products manufactured by one of the following:
    - a. CertainTeed Corp.
    - b. Knauf Insulation.
    - c. Owens Corning.
- C. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. For duct and plenum applications, provide insulation with factory-applied FSK jacket.
  - 1. Subject to compliance with requirements, provide Johns Manville 800 Series Spin-Glas insulation or equal products manufactured by one of the following:
    - a. CertainTeed Corp.
    - b. Knauf Insulation.
    - c. Owens Corning.
    - d. Manson Insulation.
- D. Mineral-Fiber, Preformed Pipe Insulation:
  - 1. Subject to compliance with requirements, provide Johns Manville Micro-Lok insulation or equal products manufactured by one of the following:
    - a. Knauf Insulation; 1000 Pipe Insulation.
    - b. Owens Corning; Fiberglas Pipe Insulation.

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2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ-SSL.
  3. Provide High-impact-resistant, UV-resistant PVC jacketed fitting covers complying with ASTM D 1784, Class 16354-C; Flame spread 25 or less; Smoke development 50 or less.
- E. Mineral-Fiber Tank Insulation: Mineral or glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory-applied FSK jacket.
1. Subject to compliance with requirements, provide Johns Manville Micro-Flex insulation or equal products manufactured by one of the following:
    - a. Knauf Insulation; Pipe and Tank Insulation.
    - b. Owens Corning; Fiberglas Pipe and Tank Insulation.
- F. Polyisocyanurate Board: Closed cell polyiso-foam board bonded on each side with a foil face. Flame Spread 25 or less: smoke development less than 450.
1. Subject to compliance with requirements, provide Johns Manville XSPECT Polyiso Foam Board. Exterior use only.

2.2 FIRE-RATED INSULATION SYSTEMS

- A. Subject to compliance with requirements, provide 3M Duct Wrap 615+.
- B. Fire-Rated Blanket: high-temperature fiber blanket thermal insulation encapsulated in a fiberglass reinforced aluminized polyester foil. Duct Wrap density shall be nominal 6 p.c.f. and have a nominal 1-1/2 in. thickness. The fiber blanket shall have a continuous use limit of 1832 °F.
- C. Smoke Developed Index and Flame Spread Index of the bare blanket, and of the foil encapsulated blanket shall be 0/0. The foil encapsulation shall be bonded to the core blanket material.

2.3 EXTERIOR DUCT AND PLENUM INSULATION SYSTEM

- A. Provide a pre-manufactured interlocking insulated panel system. System shall be a Techna-Duc system by PTM Manufacturing, LLC. The system shall include a 20-year warranty.
- B. Insulation material shall be composed of a laminated 1½" and ½" polyisocyanurate sheets totaling a finish of 2" thick; plus a minimum of ½" thickness required to cover duct supports and connection flanges. The total system "R" value is required to equal R -14.
- C. Provide a weather barrier fabricated of .032" aluminum embossed panels with the roof sloped for proper drainage. Exposed seams are to be caulked and sealed weather tight per the manufacturer's requirements.

2.4 ACOUSTICAL PIPE AND DUCT COMPOSITE INSULATION

- A. Where indicated on the drawings, provide HUSH WRAP model LVQ-210-LAG composite external sound insulation as manufactured by BRD Noise and Vibration Control, Inc.
- B. The product shall consist of 2" thick quilted fiberglass blanket bonded to a 1 lb/sf density mass loaded vinyl sound barrier. The outside barrier surface to have FSK foil facing to match non-acoustical thermal only insulation products.

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- C. Flammability shall be Class 1 per ASTM E-84.
- D. Acoustical Performance: the composite material shall have transmission loss and STC values per the following:
  - 1. 125 HZ - 19.
  - 2. 250 HZ - 20.
  - 3. 500 HZ - 23.
  - 4. 1 K HZ - 33.
  - 5. 2K HZ - 44.
  - 6. 4K HZ - 53.
  - 7. STC - 30.

2.5 CEMENTS, ADHESIVES, SEALANTS AND MASTICS

- A. Provide all required types of cements, adhesives, sealants, mastics and other accessories required to install all insulation materials and systems. Prepare surfaces as required by the insulation manufacturers. Install cements, adhesives, sealants and mastics per manufacturer's recommendations.

2.6 PVC JACKETING

- A. PVC jacketing, 30 mil thickness with flame spread of 25 or less and a smoke development of 50 or less. Temperature rating 150 degrees F.
  - 1. Subject to compliance with requirements, provide Johns Manville Zeston Jacketing or equal.

2.7 CORRUGATED ALUMINIUM JACKETING

- A. Corrugated aluminum jacketing, .020 mm thickness. ASTM Standard C1729.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes per the manufacturer's instruction with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
  - 1. Install insulation continuously through hangers and around anchor attachments.
  - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
  - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
  - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets per manufacturer's instructions.
- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

### 3.2 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations. Seal penetrations with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
- F. Insulation Installation at Floor Penetrations:

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1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.
2. Pipe: Install insulation continuously through floor penetrations.
3. Seal penetrations through fire-rated assemblies.

3.3 EQUIPMENT, TANK, AND VESSEL INSULATION INSTALLATION

- A. Mineral Fiber, Pipe and Tank Insulation Installation for Equipment, Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
  1. Apply adhesives according to manufacturer's recommended coverage rates.
  2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
  3. Protect exposed corners with secured corner angles.
  4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels.
  5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
  6. Stagger joints between insulation layers at least 3 inches.
- B. Flexible Elastomeric Thermal Insulation Installation for Equipment, Tanks and Vessels: Install insulation over entire surface of tanks and vessels.
  1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
  2. Seal longitudinal seams and end joints.
- C. Insulation Installation on Pumps:
  1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism. Fabricate boxes from aluminum, at least 0.050 inch thick. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.4 GENERAL PIPE INSULATION INSTALLATION

- A. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Union and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
  1. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
  2. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves,

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- insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
3. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.
  4. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
  5. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
  6. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
  7. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
- B. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

3.5 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

- A. Seal longitudinal seams and end joints with adhesives to eliminate openings in insulation that allow passage of air to surface being insulated.
- B. Insulate all pipe fittings, elbows, valves and pipe specialties.
- C. Apply weather resistant coating on all exterior insulation to protect the insulation from ultraviolet rays. Provide Armaflex WB Finish water based coating or equal.

3.6 MINERAL-FIBER INSULATION INSTALLATION

- A. Insulation Installation on Straight Pipes and Tubes per manufacturer's instructions. Where vapor barriers are required, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.
- B. Insulation Installation on Pipe Fittings, Elbows, Valves and Pipe Specialties:
  1. Install preformed sections of same material as straight segments of pipe insulation when available.
  2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
  3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.

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4. Install insulation to flanges as specified for flange insulation application.
- C. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins, apply adhesives according to manufacturer's recommended coverage rates per unit area.
1. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
  2. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.
- D. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins. Apply adhesives according to manufacturer's recommended coverage rates per unit area.
1. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
  2. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.7 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Where fire-rated insulation is indicated on the drawings, secure the insulation to ducts and duct hangers and supports to maintain a continuous fire rating. Insulate duct access panels and doors to achieve same fire rating as duct. Install fire-stopping at penetrations through fire-rated assemblies.

3.8 DUCT INSULATION SCHEDULE, GENERAL

- A. Duct systems requiring insulation on the exterior of the ducts:
1. Indoor exposed and concealed supply air and outdoor air ducts.
  2. Indoor, exposed and concealed return air ducts located in an unconditioned space.
  3. Indoor, exposed and concealed exhaust between isolation damper and penetration of building exterior.
  4. Indoor, exposed and concealed, Type I kitchen hood exhaust.
  5. Supply and return ducts located on the exterior of the building.
  6. Other locations noted on the drawings.
- B. Items Not Insulated:
1. Ducts with interior duct liner, unless otherwise noted.
  2. Indoor exposed supply air ducts in heating only systems located in a conditioned space.
  3. Indoor, exposed and concealed return ducts located in conditioned space.
  4. Factory-insulated flexible ducts.
  5. Factory-insulated plenums and casings.



6. Flexible connectors.
7. Factory-insulated access panels and doors.
8. Other locations noted on the drawings.

### 3.9 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Concealed supply air ducts and plenums, hydronic coils furnished on VAV air terminal units and hydronic duct coils shall be insulated with:
  1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density; uncompressed "R" value 8.0; with vapor barrier having a maximum permeance of 0.05 perm.
- B. Concealed return air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density; uncompressed "R" value 6.0; with vapor barrier having a maximum permeance of 0.05 perm.
- C. Concealed outdoor air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Blanket: 2 inches thick and 1.5-lb/cu. ft. nominal density; uncompressed "R" value 8.0; with vapor barrier having a maximum permeance of 0.05 perm.
- D. Concealed exhaust air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Blanket: 1-1/2 inches thick and 1.5-lb/cu. ft. nominal density; uncompressed "R" value 8.0; with vapor barrier having a maximum permeance of 0.05 perm.
- E. Concealed and exposed Type I, Commercial, Kitchen Hood Exhaust Duct and Plenum Insulation: Fire-rated duct wrap with a thickness as required to achieve 2-hour fire rating.
- F. Exposed supply-air ducts, plenums and all hydronic coils shall be insulated with:
  1. Mineral-Fiber Board: 2 inches thick, 3-lb/cu. ft. density, "R" 8.7 with vapor barrier.
- G. Exposed return-air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Board: 1-1/2 inches and 3-lb/cu. ft. density, "R" 6.5 with vapor barrier.
- H. Exposed exhaust air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Board: 1-1/2 inches thick and 3-lb/cu. ft. density, "R" 8.7 with vapor barrier.
- I. Exposed outdoor-air ducts and plenums shall be insulated with:
  1. Mineral-Fiber Board: 2 inches thick and 3-lb/cu. ft. density, "R" 8.7 with vapor barrier.

### 3.10 EXTERIOR DUCT AND PLENUM INSULATION SCHEDULE

- A. Provide an exterior panel insulation system as specified in Part 2. The system shall be installed by a factory certified installer and shall be covered with a 20-year limited warranty. The installing contractor shall provide a factory certified warranty after the installation has been completed and inspected by P.T.M. Manufacturing, LLC.

### 3.11 EQUIPMENT INSULATION SCHEDULE

- A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.
- B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.
- C. Chillers: Insulate cold surfaces on chillers, including, but not limited to, evaporator bundles, condenser bundles, heat-recovery bundles, suction piping, compressor inlets, tube sheets, water boxes, and nozzles with one of the following:
  - 1. Cellular Glass: 2 inches thick.
  - 2. Flexible Elastomeric: 1 inch thick.
  - 3. Mineral-Fiber Board: 1 inch thick and 3-lb/cu. ft. nominal density.
  - 4. Mineral-Fiber Pipe and Tank: 1 inch thick.
  - 5. Phenolic: 1 inch thick.
  - 6. Polyolefin: 1 inch thick.
- D. Chilled-water and dual temperature pump insulation shall be the following:
  - 1. Flexible Elastomeric: 1.5 inches thick.
- E. Chilled-water expansion/compression tank insulation shall be:
  - 1. Flexible Elastomeric: 1 inch thick.
- F. Heating-hot-water expansion/compression tank insulation shall be:
  - 1. Mineral-Fiber Pipe and Tank: 1 inch thick.
- G. Chilled-water air-separator insulation shall be:
  - 1. Flexible Elastomeric: 2 inches thick.
- H. Heating-hot-water air-separator insulation shall be the following:
  - 1. Mineral-Fiber Pipe and Tank: 2 inches thick.

### 3.12 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
  - 1. Drainage piping located in crawl spaces.
  - 2. Underground piping.
  - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

### 3.13 INDOOR PIPING INSULATION SCHEDULE

- A. Condensate and Equipment Drain Water Piping:

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1. All Pipe Sizes: Insulation shall be Flexible Elastomeric: 3/4 inch thick.
- B. Make-up Water:
  1. All sizes: Insulation shall be Mineral-Fiber, 1 inch thick with vapor barrier.
- C. Chilled Water Piping:
  1. NPS 1 ½ inches and smaller, insulation shall be:
    - a. Mineral-Fiber, 1 ½ inches thick with vapor barrier.
  2. NPS 2 inches and larger, insulation shall be: Mineral-Fiber, 2 inches thick with vapor barrier.
- D. Dual Temperature Piping:
  1. NPS 1 ¼ inches and smaller, insulation shall be Mineral-Fiber with vapor barrier: 1½" thick.
  2. NPS 1 ½ inches and larger, insulation shall be Mineral-Fiber with vapor barrier: 2" thick.
- E. Refrigerant piping and hot-gas piping:
  1. Flexible Elastomeric, 1" inches thick.
- F. Heating-Hot-Water Supply and Return:
  1. NPS 1 ¼ inches and smaller, insulation shall be Mineral-Fiber: 1½" thick with vapor barrier.
  2. NPS 1 ½ inches and larger, insulation shall be Mineral-Fiber: 2" thick with vapor barrier.

3.14 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

- A. Chilled Water Supply and Return: All Pipe Sizes: Insulation shall be:
  1. Mineral-Fiber, Preformed Pipe Insulation, 3 inches thick with vapor barrier and corrugated aluminum jacket for pipe and fittings. Install aluminum jacket with seams on the bottom of horizontal pipe.
- B. Refrigerant Liquid, Suction and Hot-Gas Piping:
  1. All Pipe Sizes: Insulation shall be Flexible Elastomeric, 1 inch thick with PVC jacket.

3.15 ACOUSTICAL PANEL INSTALLATION

- A. Comply with the manufacturer's installation requirements. Prior to installing acoustical panels, make certain that surfaces to which adhesive will be applied are clean and free of dust, dirt, and other residues that would inhibit a proper bond. Secure panels to surfaces utilizing the manufacturer's recommended non-toxic water-based adhesive.

3.16 ACOUSTICAL PIPE AND DUCT COMPOSITE INSULATION INSTALLATION

- A. Comply with the manufacturer's installation requirements.

END OF SECTION 23 07 00