

SECTION 23 07 00

HVAC AND PLUMBING INSULATION

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. HVAC and plumbing piping insulation, jackets and accessories.
2. HVAC and plumbing equipment insulation, jackets and accessories.
3. Pipe insulation jackets.
4. Equipment insulation jackets.
5. Insulation accessories including vapor retarders and accessories
6. HVAC ductwork insulation, jackets and accessories.
7. Insulation accessories including vapor retarders and accessories.

B. Related Sections:

1. Division07 - Firestopping: Product requirements for firestopping for placement by this section.
2. Division09 - Painting and Coating: Execution requirements for painting insulation jackets and covering specified by this section.
3. Division23 – Hangers and Supports for HVAC and Plumbing Piping and Equipment: Product and Execution requirements for inserts at hanger locations.
4. Division23 – Identification for HVAC and Plumbing Piping and Equipment: Product requirements for HVAC piping and equipment identification.

1.02 REFERENCES

A. ASTM International:

1. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
2. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
3. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.
4. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.
5. ASTM C450 - Standard Practice for Prefabrication and Field Fabrication of Thermal Insulating Fitting Covers for NPS Piping, Vessel Lagging, and Dished Head Segments.
6. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.
7. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
8. ASTM C547 - Standard Specification for Mineral Fiber Pipe Insulation.
9. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
10. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
11. ASTM C585 - Standard Practice for Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
12. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation.
13. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
14. ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
15. ASTM C921 - Standard Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

16. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).
17. ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.
18. ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
19. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.
20. ASTM D4637 - Standard Specification for EPDM Sheet Used in Single-Ply Roof Membrane.
21. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
22. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.
23. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

B. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.

C. National Fire Protection Association:

1. NFPA 255 - Standard Method of Test of Surface Burning Characteristics of Building Materials.

D. Underwriters Laboratories Inc.:

1. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
2. UL 1978 - Standard for Safety for Grease Ducts.

1.03 SUBMITTALS

- A. Division01 - Submittal Procedures: Submittal procedures.
- B. Product Data: Submit product description, thermal characteristics and list of materials, R value, finished accessories and thickness for each service, and location.
- C. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.
- D. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.04 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Applicator: Company specializing in performing work of this section with minimum three years documented experience, approved by manufacturer.

1.05 QUALITY ASSURANCE

- A. Test pipe insulation for maximum flame spread index of 25 and maximum smoke developed index of not exceeding 50 in accordance with ASTM E84, UL 723, and NFPA 255.
- B. Pipe insulation manufactured in accordance with ASTM C585 for inner and outer diameters.
- C. Factory fabricated fitting covers manufactured in accordance with ASTM C450.

- D. Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics and adhesives) with flame spread index of 25 or less, and smoke developed index of 50 or less, in accordance with UBC standard No. 42-1 except where more stringent requirements are noted.
- E. Insulation materials shall be tested by Underwriters Laboratories, Inc. (UL). Tests shall include insulation, jackets, fittings, adhesives, coatings and accessories. Composite products shall meet the fire hazard requirements of NFPA 90A.
- F. Furnish affidavit from manufacturer that products delivered to project meet requirements specified
- G. Maintain one copy of each document on site.

1.06 PRE-INSTALLATION MEETINGS

- A. Division01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Division01 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density, thickness and fire hazard indexes of products.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping. Do not install damaged or wet insulation, remove from project site.

1.08 ENVIRONMENTAL REQUIREMENTS

- A. Division01 - Product Requirements: Environmental conditions affecting products on site.
- B. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.
- C. Maintain temperature before, during, and after installation for minimum period of 24 hours.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Division01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for man made fiber.

PART 2 PRODUCTS

2.01 ACCEPTABLE MANUFACTURER

- A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:
 - 1. Owens Corning Fiberglass Corp.
 - 2. Armstrong World Industries, Inc.

3. Certainteed Corp.
4. Knauf Fiber Glass GmbH.
5. Rubatex Corp.

2.02 PIPING INSULATION MATERIALS

- A. Fiberglass (Mineral Fiber) Piping Insulation: ASTM C547, Class 1 unless otherwise indicated. Owens Corning Fiberglass Corp., ASJ/SL-II, Manville Products Corp. Micro-Lok, or equivalent.
- B. Calcium silicate piping insulation: ASTM C533, Type I. Kaylo asbestos free" or equivalent.
- C. Jackets for Piping Insulation: ASTM C921, Type I (Vapor Barrier) for piping with temperatures below ambient. Type I insulation may be used for all piping at the installer's option.
 1. All insulated pipes and fittings in the boiler rooms, chiller rooms, pump rooms, mechanical rooms and exposed piping in the interior areas shall be covered with PVC covers, except chilled water systems insulated with Owens Corning Vaporwick. Fitting shall have one-piece remolded PVC covers, fastened as per manufacturer's recommendations. Zeston PVC insulation covers, Fiberglass, Inc. or equal.
 2. Encase exterior piping insulation with aluminum jacket with weatherproof construction. Unjacketed fiberglass insulation meeting ASTM C-547, Class I, may be used at Developer Design/Builder's option.
- D. Staples, Bands, Wires, and Cement: As recommended by insulation manufacturer for applications indicated.
- E. Adhesives, Sealers, and Protective Finishes: As recommended by insulation manufacturer for applications indicated.

2.03 DUCTWORK INSULATION MATERIALS

- A. Rigid Fiberglass Ductwork Insulation: ASTM C612, Class 1, 3-5 lbs/ft3.
- B. Flexible Fiberglass Ductwork Insulation: ASTM C1290, with ASTM C1136 Type II vapor barrier jacket. Owens-Corning Fiberglass All Service Wrap Insulation, Type 75 or equivalent R-value:
 1. R8 minimum installed insulation for all supply and return ducts. Applies to ducts located in unconditioned spaces, such as outdoors, spaces between roof and insulated ceiling, space directly under roof, unconditioned crawl space.
 2. R4.2 minimum installed insulation for all supply ducts for all "other" spaces not listed above (i.e., conditioned space).
 3. Additions, alternations, and repairs (all climate zones)
 - a. R8 minimum installed insulation for all supply and return ducts (unconditioned spaces – see above) and R4.2 installed insulation for all supply ducts (conditioned spaces – see above) whenever:
 - 1) Ducts are to be extended to serve a new addition.
 - 2) New ducts are installed or existing ducts replaced with new ducts in an existing building.
 - 3) Density of 0.75 pcf (Type 75) and thicknesses below shall be used to provide installed R-value as follows:
 4. Nominal 1 inch thickness or equivalent to provide installed R-value as follows:
 - a. Type 75 1-1/2" Thick R = 4.2
 - b. Type 75 3 " Thick R = 8.3

- C. Ductwork Insulation Accessories: Provide staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.
- D. Ductwork Insulation Compounds: Provide cements, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

2.04 EQUIPMENT INSULATION MATERIALS

- A. Flexible Fiberglass Equipment Insulation: ASTM C553, Type II, Class F-1, Owens-Corning Fiberglass, Inc., Type 702, 2.3 lbs./ft³.
- B. Calcium Silicate Equipment Insulation: ASTM C533, Type I, Block; Owens-Corning Fiberglass, Inc., Kaylo Asbestos Free, U-Grooved block insulation.
- C. Jacketing Material for Equipment Insulation: Provide Zeston heavy gauge insulated PVC material to cover the equipment.
- D. Equipment Insulation Compounds: Provide adhesives, cements, sealers, mastics, and protective finishes as recommended by insulation manufacturer for applications indicated.
- E. Equipment Insulation Accessories: Provide staples, bands, wire, wire netting, tape corner angles, anchors and stud piping as recommended by insulation manufacturer for applications indicated.

2.05 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board:
 - 1. Manufacturers:
 - a. Johns Manville; Super Firetemp M, or equal
 - 2. Structural grade, press molded, xonolite calcium silicate, fireproofing board suitable for operating temperatures up to 1,700 degrees F. Comply with ASTM C656, Type II, Grade 6. UL tested and certified to provide 2 hour fire rating.
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL tested and certified to provide a 2-hour fire rating.
 - 1. Manufacturers:
 - a. Certainteed Corp.; Flame Check
 - b. Johns Manville; Super Firetemp Wrap
 - c. Nelson Firestop Products: Nelson FSB Flameshield Blanket.
 - d. 3M; Fire Barrier Wrap Products.
 - e. Unifrax Corp.; Fyre Wrap
 - f. Or equal.

2.06 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1.
- B. Aluminum Jacket: Stucco-embossed finish sheets manufactured from aluminum alloy complying with ASTM B 209, and having an integrally bonded moisture barrier over entire surface in contact with insulation. Metal thickness shall be .024" for outdoor applications.
 - 1. Moisture Barrier: 3-mil- thick, heat-bonded polyethylene or Kraft paper.

- C. Stainless Steel Jacket: Deep corrugated sheets of stainless steel complying with ASTM A666, Type 304 or 316, 0.16 inch thick, and roll stock ready for shop or field cutting and forming to indicated sizes.
 - 1. Moisture Barrier: 3 mil thick, heat bonded polyethylene and kraft paper.
 - 2. Jacket Bands: Stainless steel, Type 304, 3/4 inch wide.

2.07 ALUMINUM PIPE JACKET

- A. ASTM B209, 0.025 inch thick sheet.
- B. Finish: Embossed
- C. Joining: Longitudinal slip joints and 2 inch laps
- D. Fittings 0.016 inch thick die shaped fitting covers with factory attached protective liner.
- E. Metal Jacket Bands: 3/8 inch wide, 0.015 inch thick aluminum.

2.08 STAINLESS STEEL PIPE JACKET

- A. ASTM A167 Type 302, 304, or 316 stainless steel.
- B. Thickness 0.016 inch thick
- C. Finish: Corrugated.
- D. Metal Jacket Bands 3/8 inch wide, 0.010 inch thick stainless steel.

2.09 INSULATING CEMENTS (DUCTWORK AND EQUIPMENT)

- A. Mineral Fiber Insulating Cement: Comply with ASTM C 195.
 - 1. Manufacturers:
 - a. Insulco, Division of MFS, Inc.: Triple I.
 - b. P.K. Insulation Mfg. Co., Inc.: Super-Stik
 - c. Or equal.
- B. Mineral Fiber Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.
 - 1. Manufacturers:
 - a. Insulco, Division of MFS, Inc.: SmoothKote.
 - b. P.K. Insulation Mfg. Co., Inc.: P.K. No. 127 and Quick-Cote
 - c. Rock Wool Manufacturing Co.; Delta One Shot
 - d. Or equal.

2.10 ADHESIVES (DUCTWORK)

- A. Manufacturers:
 - 1. Childers Products, Division of ITW; CP-82.
 - 2. Foster Products Corporation, H. B. Fuller Company; 85-20.
 - 3. ITW TACC, Division of Illinois Tool Works; S-90/80
 - 4. Marathon Industries, Inc.; 225

5. Mon-Eco Industries, Inc.; 22-25
6. Or equal

B. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

2.11 MASTICS (DUCTWORK)

A. Manufacturers:

1. Childers Products, Division of ITW; CP-35.
2. Foster Products Corporation, H. B. Fuller Company; 30-90.
3. ITW TACC, Division of Illinois Tool Works; CB-50
4. Marathon Industries, Inc.; 590
5. Mon-Eco Industries, Inc.; 55-40
6. Vimasco Corp.; 749
7. Or equal

B. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

C. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

D. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.

E. Service Temperature Range: Minus 20 to plus 180 degrees F.

F. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.

G. Color: White.

2.12 SEALANTS

A. FSK and Metal Jacket:

1. Manufacturers:

- a. Childers Products, Division of ITW; CP-76-8
- b. Foster Products Corp. H.B. Fuller Co.; 95-44
- c. Marathon Industries, Inc., 405
- d. Mon-Eco Industries, Inc.; 44-05
- e. Vimasco Corp; 750
- f. Or equal.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.

B. ASJ Flashing Sealants (Ductwork)

1. Manufacturer: Childers Products, Division of TTW; CP-76

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire and water resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 degrees F.
5. Color: White

2.13 ACCESSORIES AND ATTACHMENTS (DUCTWORK)

- A. Weld-Attached Anchor Pins and Washers: Copper-coated steel pin for capacitor-discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 1. Welded Pin Holding Capacity: 20 lb for direct pull perpendicular to the attached surface.
- B. Adhesive-Attached Anchor Pins and Speed Washers: Galvanized steel plate, pin, and washer manufactured for attachment to duct and plenum with adhesive. Pin length sufficient for insulation thickness indicated. May be used for heating and hot water systems.
 1. Adhesive: Recommended by the anchor pin manufacturer as appropriate for surface temperatures of ducts, plenums, and breechings; and to achieve a holding capacity of 20 lb for direct pull perpendicular to the adhered surface.
- C. Bands: Minimum 1/2 inch wide, in one of the following materials compatible with jacket:
 1. Stainless Steel: ASTM A666, Type 304; 0.020 inch thick.
 2. Aluminum 0.007 inch thick.
- D. Wire: 0.080 inch, nickel copper alloy, 0.062 inch soft annealed stainless steel, or 0.062 inch soft annealed galvanized steel.
- E. Weld Attached Anchor Pins and Washers for Chilled Water System: Copper coated steel pin for capacitor discharge welding and galvanized speed washer. Pin length sufficient for insulation thickness indicated.
 1. Welded Pin Holding Capacity: 20 lbs for direct pull perpendicular to the attached surface.

PART 3 EXECUTION

3.01 INSPECTION

- A. Examine areas and conditions under which mechanical insulation is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

3.02 PLUMBING PIPING SYSTEM INSULATION.

- A. Insulation Omitted: Omit insulation on chrome plated exposed piping (except for handicapped fixtures), air chambers, unions, strainers check valves, balance cocks, flow regulators, drain lines from water coolers, drainage piping located in crawl spaces or tunnels, buried piping, fire protection piping, and pre-insulated equipment.
- B. Cold Piping:
 1. Application requirements: Insulate the following cold plumbing piping systems:
 - a. Plumbing drains carrying cold condensate.
 2. Insulate each piping system specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 1 inch thickness.

- C. Hot Piping:
 - 1. Application Requirements: Insulate the following hot plumbing piping system.
 - a. Potable hot water piping.
 - b. Potable hot water recirculating piping.
 - c. Hot drain piping.
 - d. Handicapped fixtures.
 - 2. Insulate each piping system specified above with one of the following types and thickness of insulation.
 - a. Fiberglass: 1 inch thick for pipe sizes up to and including 2 inch, 1-1/2 inch thick for pipe sizes over 2-1/2 inch.
 - b. Provide "Armaflex" insulation over the hot water supply and angle stop and "Trap Cap" insulation on the trap.

3.03 HVAC PIPING SYSTEM INSULATION

- A. Insulation Omitted: Omit insulation on hot unions, flanges, strainers, flexible connections and expansion joints.
- B. Cold/Chilled Piping
 - 1. Application Requirements: Insulate the cold HVAC piping systems for HVAC chilled water supply and return piping.
 - 2. Insulate each piping system specified above with the following types and thicknesses of insulation:
Fiberglass with wicking technology: : 1 inch thick for pipe sizes up to and including 4 inch, 1-1/2 inch thick for pipe sizes and over 4 inch.
- C. Hot Water and Steam Piping:
 - 1. Application Requirements: Insulate the following hot water and steam HVAC piping systems.
 - a. HVAC heating water supply and return piping.
 - b. Low pressure steam and condensate piping.
 - c. Hot gas refrigerant piping.
 - d. Medium and high pressure steam and condensate piping.
 - 2. Insulate each piping system specified above (item a, b and c) with one of the following types and thicknesses of the insulation:
 - a. Fiberglass: 1-1/2 inch thick for pipe sizes up to 1-1/2 inch; 2 inch thick for piping over 2 inch.
 - 3. Insulate medium and high pressure steam and condensate piping with fiberglass 2.5" thick for pipe up to 2 inch and 3 inch thick pipe up to 4 inch and 4 inch thick for pipe over 5 inch.
 - 4. Insulation is not required for automatic relief steam vents where the steam is only discharge or vent out periodically to relief the pressure of the steam system.
 - 5. Insulation is required for steam vents that steam is relief continuously. Insulate with fiberglass 1.5" thick.

3.04 DUCTWORK SYSTEM INSULATION:

- A. Insulation Omitted: Do not insulate lined ductwork.

B. Hot/Cold Ductwork:

1. Application Requirements: Insulate the following ductwork:
 - a. Outdoor air intake ductwork between air entrance and fan inlet or HVAC unit inlet, insulate to R-8,
 - b. HVAC supply ductwork, unconditioned space R-8, above ceiling grid indirectly conditioned space R-4.2.
 - c. HVAC return ductwork, unconditioned space R-8, above ceiling grid indirectly conditioned space R-4.2.
 - d. HVAC plenums and unit housings not pre-insulated at factory to geographical R-value requirements based on California Title 24, R-4.2, R-6 or R-8.
2. Insulate each ductwork system specified above with one of the following types and thickness of insulation as indicated:
 - a. Rigid Fiberglass: 2 inch thick, (Owens Corning 703 FRK R-8), in machine, fan and equipment rooms.
 - b. Flexible Fiberglass: Type 75 (0.75 pcf), 1-1/2 inch thick in conditioned space (R4.2) or 3 inch thick in unconditioned space (R-8), , application limited to concealed locations.

3.05 EQUIPMENT INSULATION

A. Cold Equipment (Below Ambient Temperature):

1. Application requirements: Insulate the following cold equipment:
 - a. Drip pans under chilled equipment.
 - b. Chilled water pumps: Enclosed fixed section of pump in a fixed box fabricated of insulation sections cemented and skewered together. Fill voids with loose fill glass fiber. Secure box with loose fill glass fiber. Secure box with wire ties at 3 inch on center. Similarly enclose removable section of pump with a removal box. Install 22 gage sheet metal parting gasket to fit flush with finish. Apply metal mesh and lace edges, apply 1/2 inch thick insulating cement, trowel smooth and allow to dry.
 - 1) Cover with 8 oz canvas cemented in place, apply smoothly, and finish by sizing with lagging adhesive.
 - 2) Seal boxes together with vapor barrier tape. Arrange for removal by peeling off tape. Reinstall by application of new tape.
 - c. Expansion tanks
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation:
 - a. Fiberglass: 2 inch thick for cold surfaces above 35 degrees F and 3 inch thick for surfaces 35 degrees F and lower. Acceptable materials include: Owens Corning Fiberglass Flexwrap with PSK jacketing or equivalent, or Owens Corning Fiberglass Pipe & Tank Wrap or equivalent.

B. Hot Equipment (Above Ambient Temperature):

1. Application Requirements: Insulate the following hot equipment:
 - a. Condensate pumps.
 - b. Heat exchangers

- c. Expansion tank
 - d. Air separator
2. Insulate each item of equipment specified above with one of the following types and thicknesses of insulation.
- a. Fiberglass: 2 inch thick, except 3 inch for steam jacketed heat exchangers, emergency generator muffler and connection.

3.06 INSTALLATION OF PIPING INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation on pipe systems subsequent to installation of heat tracing, painting, testing and acceptance of tests.
- C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with a single cut piece to complete run. Do not use cut pieces or scraps abutting each other.
- D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure a complete and tight fit over surfaces to be covered.
- E. Maintain integrity of vapor barrier jackets on pipe insulation, and protect to prevent puncture or other damage.
- F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.
- G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.
- H. Butt piping insulation against pipe hanger insulation inserts. For hot pipes, apply 3" wide vapor barrier tape or band over the butt joints. For chilled water piping apply insulation with wicking technology with 3 inch wide paperless tape over the butt joints.
- I. Pipe exposed to weather: Encase exterior piping with aluminum jacket with weather proof construction.
- J. Pipes in mechanical rooms (Pump rooms, Fan rooms, mechanical rooms and equipment rooms). Use pipe insulation with paperless polymer jacketing or encase piping with PVC cover.
- K. Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation. Provide high density insulation of same thickness where saddles or protection shields all located. In case where insulation with wicking technology is used, cover evaporation grid holes with paperless tape under length of saddles or shields.

3.07 INSTALLATION OF DUCTWORK INSULATION

- A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.
- B. Install insulation materials with smooth and even surfaces.

- C. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.
- D. Maintain integrity of vapor barrier on ductwork insulation, and protect it to prevent puncture and other damage.
- E. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated.
- F. Lined ductwork: Except as otherwise indicated, omit external insulation on ductwork where internal insulation or sound absorbing linings have been installed.
- G. Ductwork Exposed to Weather: Cover exposed to weather duct insulation with 26 gauge galvanized sheet metal, sides, top and bottom with standing seams. Pitch for drainage.
- H. Ductwork and sheet metal plenums exposed to view (Ductwork in the mechanical rooms): Insulate to California Title 24 requirements. If space is unconditioned provide 3 inch thick, 3/4 pounds per cubic foot density FRK faced glass fiber blanket. If space is indirectly conditioned, provide 1-1/2 inch thick 3/4 pounds per cubic foot density FRK faced glass fiber blanket. Tightly butt joints. Secure with 18 gauge tie wire. Corner angles shall overlap at least two sheet metal screws at each side.

3.08 INSTALLATION OF EQUIPMENT INSULATION

- A. General: Install equipment thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
- B. Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gaping joints and excessive voids resulting from poor workmanship.
- C. Maintain integrity of vapor barrier on equipment insulation and protect it to prevent puncture and other damage.
- D. Do not apply insulation to equipment, breechings, or stacks while hot.
- E. Apply insulation using the staggered joint method for both single and double layer construction, where feasible. Apply each layer of insulation separately.
- F. Coat insulated surfaces with layer of insulating cement, troweled in workmanlike manner, leaving a smooth continuous surface. Fill in scored block, seams, chipped edges and depressions, and cover over wire netting and joints with cement of sufficient thickness to remove surface irregularities.
- G. Cover insulated surfaces with PVC jacketing neatly fitted and firmly secured. Lap seams at least 2 inches. Apply over vapor barrier where applicable, except for emergency generator muffler, cover with aluminum jacket.
- H. Do not insulate boiler manholes, handholes, cleanouts, ASME stamp, and manufacturer's nameplate. Provide neatly beveled edge at interruptions of insulation.
- I. Provide removable insulation sections to cover parts of equipment which must be opened periodically for maintenance; include metal vessel covers, fasteners, flanges, frames and accessories.
- J. Equipment exposed to Weather: Protect outdoor insulation from weather by installation of weather barrier mastic protective finish, or jacketing, as recommended by the manufacturer.

3.09 PROTECTION AND REPLACEMENT

- A. Replace damaged insulation that cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.
- B. Protection: Insulation Installer shall advise Developer Design/Builder of required protection for insulation work during remainder of construction period, to avoid damaged and deterioration.

END OF SECTION