SECTION 20 07 00

PIPE, DUCT AND EQUIPMENT INSULATION (Revised AD-8)

PART 1 - GENERAL

1.1 DESCRIPTION

A. Description of systems:
   1. Pipe insulation, non-flexible and flexible.
   2. Duct insulation, non-flexible and flexible.
   3. Equipment insulation.
   4. Insulation jacketing and prefabricated fitting covers.
   5. Insulation fasteners:
      a. Adhesives, mastics, and caulking.

B. Definitions:
   1. Concealed: Outside surfaces are isolated from room ambient air conditions by physical barrier(s):
      a. Concealed items are typically accessed through suspended ceilings, through access doors, or by cutting and patching.
      b. Listed below are examples of spaces that typically contain concealed items:
         1) Walls.
         2) Partitions.
         3) Chases.
         4) Shafts.
         5) Alley ways.
         6) Ceiling spaces.
   2. Exposed: Outside surfaces are not isolated from room ambient air conditions by physical barrier(s):
      a. Exposed items are typically accessed directly from within a room or space.
      b. Listed below are examples of rooms/spaces that typically contain exposed items:
         1) Mechanical rooms.
         2) Rooms without ceilings.
   3. Exposed to weather: Outside surfaces are not isolated by physical barrier(s) from weather or outside ambient air conditions.
   4. Runouts: Piping not more than 12 FT in length.

1.2 QUALITY ASSURANCE

A. Comply with the following fire and smoke hazard ratings:
   1. Test products by procedure ASTM-E84, NFPA-255 and ANSI/UL-723.
   2. Rating requirements:
      a. Maximum Flame Spread: 25.
      b. Maximum Smoke Developed:
         1) Fiberglass, phenolic, PVC: 50.
         2) Elastomeric: 150.
   3. Properly identify products for flame and smoke ratings.
      a. Shipping cartons may be labeled instead of product.

B. Comply with requirements of the following specifications:
   1. ASTM-C547, "Standard Specification for Mineral Fiber Preformed Pipe Insulation."
   2. ASTM-C533, "Standard Specification for Calcium Silicate Pipe and Block Insulation."
   3. ASTM-C553, "Standard Specification for Mineral Fiber Blanket and Felt Insulation."
   4. ASTM-C585, "Recommended Practice for Inner and Outer Diameters of Rigid Pipe 'Insulation for Nominal Sizes of Pipe and Tubing (NPS System)."

5. ASTM-C612, "Standard Specification for Mineral Fiber Block and Board Thermal Insulation."
6. ASTM-C1136, "Standard Specification for Flexible Low Permeance Vapor Retarders for Thermal Insulation."
7. ASTM-C795, "Thermal Insulation for Use Over Austenitic Stainless Steel."
8. Federal Specification HH-I-558B, "Mineral Fiber Boards, Blankets, Pipe Covering."

1.3 SUBMITTALS

A. Product data:
   1. Pipe insulation.
   2. Ductwork insulation.
   3. Insulation for hot equipment.
   4. Insulation for cold equipment.
   5. Jacketing and prefabricated fitting covers.
   6. Insulation fasteners.

B. LEED Information:
   1. LEED Credits MR 5.1 and 5.2, Regional Materials: For products and materials required to comply with requirements for regional materials indicating location and distance from Project of material manufacturer and point of extraction, harvest, or recovery for each raw material. Include statement indicating cost for each regional material and the fraction by weight that is considered regional.
   2. LEED Credit EQ 4.1, Low-Emitting Materials – Adhesives and Sealants: Manufacturer's product data for construction sealants, including printed statement of VOC content.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Acceptable manufacturers:
   1. Insulation materials:
      a. Base:
         1) As indicated.
      b. Optional:
         1) Owens-Corning Fiberglass.
         2) CertainTeed Insulations.
         3) Knauf Fiber Glass.
         4) Johns-Manville.
         5) Armstrong.
   2. Jacketing:
      a. Base:
         1) As indicated.
      b. Optional:
         1) Brocar Products.
         2) Ceel.
         3) Childers Products.
         4) Johns-Manville.
         5) RPR Metals.
         6) Pabco.
         7) Truebro.
   3. Prefabricated fitting covers:
      a. Base:
         1) As indicated.
      b. Optional:
         1) Ceel.

2) CertainTeed Insulations.
3) Childers Products.
4) Knauf Fiber Glass.
5) Johns-Manville.
6) Proto Corporation.
7) RPR Metals.
8) Pabco.

4. Adhesives, mastics, caulkings, and finishes:
   a. Base:
      1) As indicated.
   b. Optional:
      1) Fuller, HB.
      2) Chicago (CMC).
      3) Childers Products.
      4) Dow Corning.
      5) Johns-Manville.

B. Insulation - General:
1. Do not use material that exceeds specified flame and smoke ratings.
2. Use permanent treatments to jacketings and facings to impart specified fire ratings.
3. Use of water soluble treatments is prohibited.
4. At hangers and bracing.

2.2 PIPE INSULATION, NON-FLEXIBLE

A. Pipe insulation, non-flexible:
1. Material: Preformed commercial-grade fiberglass or phenolic thermal insulation.
2. Designed for application on systems operating at temperatures between 0 and 850 degF.
3. Thermal conductivity at mean temperature:
   a. $k \leq 0.23$, 75 degF.
   b. $k \leq 0.29$, 200 degF.
   c. $k \leq 0.54$, 500 degF.
4. Base products:
   a. Owens-Corning Fiberglas ASJ/SSL-II.
5. Facing:
   a. All service jacket:
      1) Temperature range: -20 to 150 degF.
      2) Provide with integral vapor retarder where indicated in Part Three.
6. Seams, longitudinal: 2 IN self-sealing facing tabs:
   a. Provide adhesive on both contacting surfaces.
   b. Designed to perform without stapling.

2.3 PIPE INSULATION, FLEXIBLE

A. Pipe insulation, flexible:
1. Material: Commercial-grade closed-cell elastomeric thermal insulation.
2. Designed for application on systems operating at temperatures between 40 and 200 degF.
3. Thermal conductivity at mean temperature:
   a. $k \leq 0.27$, 75 degF.
   b. $k \leq 0.276$, 90 degF.
4. Base product: Armstrong Armaflex.
5. Seams, longitudinal: Factory-cut and self-sealing.

2.4 DUCTWORK INSULATION, NON-FLEXIBLE

A. Ductwork insulation, non-flexible:
1. Material: Commercial-grade fiberglass thermal insulation formed with a thermosetting resin into semi-rigid or rigid boards.

2. Designed for application on systems operating at temperatures between 0 and 450 degF.
3. Minimum density:
   a. Semi-rigid: 3.0 PCF.
   b. Rigid: 6.0 PCF.
4. Thermal conductivity at mean temperature:
   a. Semi-rigid:
      1) $k \leq 0.22$, 75 degF.
      2) $k \leq 0.27$, 150 degF.
      3) $k \leq 0.38$, 300 degF.
   b. Rigid:
      1) $k \leq 0.23$, 75 degF.
      2) $k \leq 0.27$, 150 degF.
      3) $k \leq 0.37$, 300 degF.
5. Base product:
   a. Owens-Corning Fiberglas Type 703 and 705 industrial insulation.
6. Facing:
   a. Unfaced, foiled-reinforced-kraft (FRK), or all-service-jacket (ASJ) depending on applications as specified in Part Three:
      1) Temperature range: -20 to 150 degF.

B. High efficiency ductwork insulation: Non-flexible Kooltherm Insulation Products, Koolphen K phenolic foam insulation with ASJ vapor barrier jacket:
   1. Thermal conductivity (k value): Not greater than 0.13.

2.5 DUCTWORK INSULATION, FLEXIBLE

A. Ductwork insulation, flexible:
   1. Material: Commercial-grade fiberglass thermal insulation.
   2. Designed for application on systems operating at temperatures between 40 and 250 degF.
   3. Thermal conductivity at mean temperature:
      a. $k \leq 0.27$, 75 degF.
   4. Base product:
      a. Owens-Corning Fiberglas commercial-grade all-service duct wrap.
   5. Facing: Foiled, reinforced-kraft vapor-retarding.
   6. Seams: 2 IN facing tab.

2.6 INSULATION FOR HOT EQUIPMENT

A. Same as Pipe Insulation, Non-flexible.

2.7 INSULATION FOR COLD EQUIPMENT

A. Insulation for cold equipment:
   1. Material: Commercial-grade elastomeric thermal insulation.
   2. Designed for application with complete adhesive coverage on systems operating at temperatures between -40 and 180 degF.
   3. Thermal conductivity at mean temperature:
      a. $k \leq 0.27$, 75 degF.
      b. $k \leq 0.276$, 90 degF.
   4. Base product: Armstrong Armaflex.

2.8 JACKETING AND PREFABRICATED FITTING COVERS

A. Jacketing and fitting covers, general:
   1. Fitting covers:
      a. Designed to fit over precut insulation inserts.
      b. Designed specifically for fitting being covered:
         1) 2-gore covers are not acceptable.

B. Jacketing and fitting covers, PVC:
   1. High impact: Minimum 0.028 IN thick.
   2. Resistant to bacterial growth, mildew, and corrosion.
   3. Installations exposed to weather:
      a. Resistant to ultra-violet rays.
      b. Designed for direct exposure to weather exposure without painting.
   4. Minimum 1 IN over-lap at joints.
   5. Base manufacturer: Johns-Manville.

C. Jacketing and fitting covers, metal:
   1. Material: As indicated in Part Three.
   2. On cold systems, ducts exposed to weather, and equipment, provide factory moisture barrier.
   3. Attaching method:
      a. 0.020 x 3/8 IN bands on 9 IN centers unless indicated otherwise in Part Three.
      b. Band material: Same as jacketing and covers.
   4. Minimum 2 IN overlap at joints.
   5. Tubular jacketing: Locking longitudinal seams.
   6. Base manufacturer: Childers.

D. Jacketing and fitting covers, vinyl:
   1. Material: Molded closed cell vinyl.
   2. Thermal conductivity at mean temperature:
      a. $k \leq 1.17$, 75 degF.
   3. Attaching method:
      a. Nylon ties.
   4. Factory cut longitudinal seams.
   5. Base manufacturer: Truebro.

2.9 INSULATION FASTENERS

A. Insulation adhesive:
   1. Childers CP-82.
   2. Foster 30-36.
   3. Halstead 77-198.
   4. Adhesive shall have a VOC content of no greater than 80 g/L in accord with SCAQMD Rule #1198.

B. Insulation mastic:
   1. Childers CP-30.
   2. Foster 35-00-GPM.
   3. Mastic shall have a VOC content of no greater than 80 g/L in accord with SCAQMD Rule #1198.

C. Insulation caulking:
   1. Dow No.11.
   2. Caulking and sealants shall have a VOC content of no greater than 250 g/L in accord with SCAQMD Rule #1198.

PART 3 - EXECUTION

3.1 APPLICATION - GENERAL

A. Apply products per manufacturer's recommendations and as specified:
   1. Allow for thermal expansion and contraction.

B. Do not insulate piping until satisfactory completion of required pressure tests.

C. Do not insulate piping until heat tracing cable has been installed. Coordinate with cable installer.

D. In general, do not insulate piping below ground:
   1. Specific exceptions may exist under "Pipe insulation, flexible."

E. Apply insulation to clean, dry surfaces with pipe, duct, and equipment surfaces at room temperature.

F. Butt edges of insulation firmly together, and seal joints with compatible jackets, facings and adhesives as specified.

G. On cold systems and equipment, apply insulation with a continuous, unbroken vapor retarder:
   1. To prevent condensation, provide insulation and vapor seals on hangers, supports, and anchors that are secured directly to cold surfaces.

H. Continue insulation through sleeves and wall and ceiling openings.

I. Insulate fittings, valve bodies, flanges and other pipeline accessories.

J. Insulation at piping supports: Coordinate with Section 20 05 29.

K. Rectangular and flat-oval ductwork exposed to weather:
   1. Apply insulation and jacketing so that top of ductwork has crown that effectively prevents pooling of water:
      a. Minimum crown slope: 1/4 IN/FT.

L. Insulation installed in multiple layers: Stagger joints between layers.

3.2 PIPE INSULATION, NON-FLEXIBLE

A. General:
   1. Provide either type of lap seal at joints:
      a. Self-sealing facing tabs.
      b. 3 IN wide pressure-sensitive joint-sealing tape that matches facing:
         1) Manufacturer: Same as insulation.
   2. Fittings:
      a. On non-serviceable items, use either the built-up system or prefabricated fitting covers.
      b. On serviceable items, use prefabricated fitting covers attached with bands:
         1) Exception: On systems exposed to weather, attach with method described as best by manufacturer.
      c. On exposed fittings, flanges, valves, and pipe terminations, use prefabricated fitting covers:
         1) Example: Mechanical rooms.
      d. Built-up system:
         1) 2 IN and smaller: Finish with mineral fiber cement to thickness of adjoining pipe insulation.
         2) 2-1/2 IN and larger: Insulate with mitered pipe insulation segments or preformed fiberglass fittings. Secure with vinyl faced insulation strapping tape or 20 AWG galvanized annealed wire finished with one coat of mineral fiber cement.
         3) After mineral fiber cement is dry, finish with Glass Fab embedded in 2 coats of Foster 30-36 adhesive.
      e. Prefabricated PVC fitting covers:
         1) All sizes: Install covers over mitered pipe-insulation segments or preformed fiberglass fittings.

B. Provide non-flexible insulation on following piping systems in wall thicknesses indicated:
   1. Hydronic systems:
      a. Cooling coil condensate drains:
         1) All sizes: 1 IN.
      b. Chilled water piping, primary and secondary:
         1) Runouts to 2 IN: 1/2 IN.
         2) 8 IN and smaller: 1 IN.
         3) 10 IN and larger: 1-1/2 IN.

c. Heating water piping (to 200 degF):
   1) Runouts to 2 IN: 1/2 IN.
   2) 2 IN and smaller: 1 IN.
   3) 2-1/2 IN and larger: 1-1/2 IN.
d. Glycol water piping including heat recovery:
   1) Runouts to 2 IN: 1/2 IN.
   2) 2 IN and smaller: 1 IN.
   3) 2-1/2 IN and larger: 1-1/2 IN.
e. Process cooling water, same as chilled water piping.

2. Plumbing systems:
   a. Domestic cold water piping, laboratory cold water piping, chilled water piping for drinking fountains:
      1) 2 IN and smaller: 1/2 IN.
      2) 2-1/2 IN and larger: 1 IN.
   b. Domestic or laboratory hot/recirculating water piping (100-130 degF):
      1) 1-1/4 IN and smaller: 1/2 IN.
      2) 1-1/2 IN and larger: 1 IN.
   c. Domestic or laboratory hot/recirculating water (140-160 degF):
      1) 2 IN and smaller: 1 IN.
      2) Over 2 IN: 1-1/2 IN.
   d. Hot water and waste lines below handicapped accessible lavatories and sinks:
      1) All sizes: 1/2 IN.
      2) Waste lines are hot systems.
   e. Horizontal above grade storm drainage and overflow storm drainage piping within the building (including 24 IN up and down from horizontal and up to underside of roof deck):
      1) All sizes: 1 IN.
      2) These are cold systems.
3. Steam systems:
   a. Steam piping (0-15 PSIG, 201-250 degF):
      1) Runouts to 1-1/2 IN: 1 IN.
      2) 1-1/2 IN and smaller: 1-1/2 IN.
      3) Over 2 IN and over: 2 IN.
   b. Steam piping (15-70 PSIG, 251-316 degF):
      1) Runouts to 2 IN: 1-1/2 IN.
      2) 1 IN and smaller: 2 IN.
      3) 1-1/4 to 4 IN: 2-1/2 IN.
      4) Over 4 IN: 3 IN.
   c. Steam piping (Over 70 PSIG, 316 degF):
      1) Runouts to 2 IN: 1-1/2 IN.
      2) 1 IN and smaller: 2-1/2 IN.
      3) 1-1/4 - 2 IN: 2-1/2 IN.
      4) 2-1/2 - 4 IN: 3 IN.
      5) Over 4 IN: 3-1/2 IN.
   d. Steam condensate, pumped condensate return, condensate vent, blowdown, and exhaust steam (all temperatures) piping:
      1) 1 IN and smaller: 1 IN.
      2) 1-1/4 to 2 IN: 1-1/2 IN.
      3) Over 2 IN: 2 IN.

3.3 PIPE INSULATION, FLEXIBLE

A. General:
   1. Install by slipping insulation over piping.
   2. Do not make longitudinal field cuts.
   3. Seal joints with manufacturer approved adhesive.

4. Do not use flexible pipe insulation on systems with heat tracing cable or temperature maintenance cable.

B. Fittings:
1. Insulate fittings and valve bodies with segments cut from pipe insulation.

C. Provide flexible insulation on following piping systems in wall thicknesses indicated:
1. Hydronic systems:
a. Cooling coil condensate:
1) 2 IN and smaller: 1/2 IN.
b. Chilled water runouts:
1) 2 IN and smaller: 1/2 IN.
2) Included are runouts to fan coil units.
c. Heating water runouts:
1) 2 IN and smaller: 1/2 IN.
2) Included are runouts to fan coil units, unit heaters, finned tube radiation, and terminal units.
2. Plumbing systems:
a. Domestic cold water piping, non-potable cold water piping:
1) 2 IN and smaller: 1/2 IN.
2) Flexible insulation only permitted on branch piping concealed within partition or plumbing chase directly behind fixtures being served.
b. Domestic or laboratory hot/recirculating water piping:
1) 2 IN and smaller: 1/2 IN.
2) Flexible insulation only permitted on branch piping concealed within partition or plumbing chase directly behind fixtures being served.
c. Waste piping from water coolers and drinking fountains to first point of mixing with waste from a different type of fixture:
1) All sizes: 1/2 IN.

3.4 DUCTWORK INSULATION, NON-FLEXIBLE

A. General:
1. Secure insulation to ductwork by impaling over welded-pin or adhesive-pin mechanical fasteners:
a. Secure insulation on mechanical fasteners with speed clips.
b. Space mechanical fasteners to hold insulation securely in place:
1) Maximum spacing: 12 IN centers.
2. Where access is not possible for pin attachment, use adhesive or caulk:
a. Cover entire surface with brush applied adhesive.
b. Apply caulk in continuous bead on 6 IN centers.
3. Seal joints and speed clips with 3 IN wide pressure-sensitive joint-sealing tape that matches facing:
a. Staple corners of tape with outward clinching staples.
4. Cold systems only: Coat staples with mastic.
5. Reinforce edges with metal corner angles.
6. Do not apply insulation over coil and damper access panels.
7. Do not apply insulation over internally lined ductwork: Coordinate with Section 23 31 13.
8. Use FRK facing on concealed ductwork.
9. Use ASJ facing on exposed ductwork.

B. Provide non-flexible insulation on following ductwork in thicknesses indicated:
1. Outside-air ductwork (rectangular):
a. All sizes: 2 IN.

AD-8: Section 20 07 00: Add paragraph 3.4.B.2. and renumber.
2. Supply-air ductwork in mechanical equipment room:
a. All sizes: 1-1/2 IN.

~~2.~~3. Factory-packaged air handling units, mixed-air plenum and ductwork, component housings to fan unit inlet including transition sections and prefilter:
   a. All sizes: 2 IN.
~~3.~~4. Relief-air/exhaust-air plenums behind louvers:
   a. All sizes: 2 IN.
~~4.~~5. Exhaust duct upstream of fans exposed to weather with ASJ facing, 2 IN.
~~5.~~6. Relief and exhaust air ducts in mechanical rooms between plenum and isolation dampers plus 36 IN.

3.5 DUCTWORK INSULATION, FLEXIBLE

A. General:
   1. On ductwork 24 IN wide and less, secure insulation to bottom of ductwork with 4 IN wide bands of brush-applied adhesive on 12 IN centers.
   2. On ductwork over 24 IN wide, secure insulation to bottom of ductwork by impaling over welded-pin or adhesive-pin mechanical fasteners:
      a. Secure insulation on mechanical fasteners with speed clips.
      b. Space mechanical fasteners to hold insulation securely in place:
         1) Maximum spacing: 12 IN centers.
      c. Seal speed clips with 3 IN wide pressure-sensitive joint-sealing tape that matches jacket:
         1) Staple corners of tape with outward clinching staples.
         2) Cold systems only: Seal staples with mastic.
   3. Provide either type of lap seal at joints:
      a. Seal facing tab over adjoining facing with lap adhesive:
         1) Secure lap with outward clinching staples on 6 IN centers.
      b. Use 3 IN wide pressure-sensitive joint-sealing tape that matches facing:
         1) Secure both sides of tape with outward clinching staples on 6 IN centers.
      c. Cold systems only: Seal staples with mastic.
   4. Apply insulation to ductwork from air handling unit housing to ends of duct runs, including diffuser necks and register ducts, and silencers.
   5. Do not apply insulation over coil and damper access panels.
   6. Do not apply over internally lined ductwork: Coordinate with Section 23 31 13.

B. Provide flexible insulation on following ductwork in thicknesses indicated:
   1. Supply-air ductwork (including downstream of terminal units) except where covered by non-flexible insulation:
      a. All sizes: 1-1/2 IN.
   2. Return-air ductwork in non-air conditioned areas (including utility shafts):
      a. All sizes: 1-1/2 IN.
      b. Ceiling spaces directly above conditioned spaces are considered conditioned.
   3. Silencers in ducts are included.
   4. Return-air/relief-air ductwork from relief plenum at louver (or other outside opening) back to relief-air damper plus 36 IN:
      a. All sizes: 1-1/2 IN.

3.6 INSULATION FOR HOT EQUIPMENT

A. General:
   1. Secure insulation to bottom of flat surfaces wider than 24 IN by impaling over adhesive-pin mechanical fasteners:
      a. Secure insulation on mechanical fasteners with speed clips.
      b. Space mechanical fasteners to hold insulation securely in place:
         1) Maximum spacing: 12 IN centers.
   2. Seal joints and speed clips with 3 IN wide pressure-sensitive joint-sealing tape that matches facing:

a. Secure both sides of tape with outward clinching staples on 3 IN centers, 1/4 IN from edge.

3. Insulate flanges and fittings as indicated under "Pipe insulation, non-flexible."
4. Reinforce ends and irregular surfaces with Glass Fab embedded in 2 coats of Foster 30-36 adhesive.

B. Provide hot-equipment insulation on following equipment in thicknesses indicated:
1. Flash tanks: 2 IN.
2. Heat exchangers: 2 IN.
3. Steam meters.

C. Provide removable insulation jacket for all devices, like pressure reducing valves, which require service.

3.7 INSULATION FOR COLD EQUIPMENT

A. Apply insulation with manufacturer's approved adhesive:
1. Completely cover joining surfaces (equipment surfaces, and back and butting edges of insulation).
2. Apply with 1/8 IN overlay pressure on butt joints.
3. Apply 2 coats of manufacturer's approved white latex enamel to outside layer.

B. Provide cold-equipment insulation on following equipment in number of layers and total thicknesses indicated:
1. Chilled water pump casing: 1 layer, 3/4 IN.
2. Domestic and chilled water meter: 1 layer, 3/4 IN.
3. All above grade drain bodies which convey rain water: 1 layer, 3/4 IN.
4. Chilled water expansion tanks: 1 layer, 3/4 IN.
5. Chilled water air separators: 1 layer, 3/4 IN.
6. Water-to-water heat exchangers: Layer 3/4 IN.

3.8 JACKETING AND PREFABRICATED FITTING COVERS

A. General:
1. Stagger jacketing and insulation joints.

B. Systems exposed to weather:
1. Material:
a. 0.016 IN smooth aluminum.
2. Attach with method described as best by manufacturer.
3. Joints:
a. Orient joint laps to prevent entry of water.
b. Seal joints weather tight.

C. Hot equipment:
1. Material:
a. 0.016 IN smooth aluminum.
2. Attach with method described as best by manufacturer.

3.9 HOT WATER AND WASTE LINES EXPOSED BENEATH ACCESSIBLE FIXTURES

A. Hot water and waste lines exposed beneath accessible fixtures, see Section 22 42 00.

END OF SECTION