

## PART 1 - GENERAL

### 1.1 REFERENCES

#### AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR-CONDITIONING ENGINEERS, INC. (ASHRAE)

ASHRAE 90.1 (1989; Errata 1990, Addendum 1992 and 1993) Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings

ASHRAE 90.2 (1993; Addenda 1994 and 1995) Energy Efficient Design of New Low-Rise Residential Buildings

#### AMERICANSOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A 167 (1996) Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

ASTM B 209 (1996) Aluminum and Aluminum-Alloy Sheet and Plate

ASTM C 195 (1995) Mineral Fiber Thermal Insulating Cement

ASTM C 533 (1995) Calcium Silicate Block and Pipe Thermal Insulation

ASTM C 534 (1994) Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

ASTM C 553 (1992) Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

ASTM C 591 (1994) Un-faced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation

ASTM C 612 (1993) Mineral Fiber Block and Board Thermal Insulation

ASTM C 916 (1985; R 1990) Adhesives for Duct Thermal Insulation

ASTM C 1136 (1995) Flexible, Low permeance Vapor Retarders for Thermal Insulation

ASTM E 84 (1997; Rev. A) Surface Burning Characteristics of Building Materials

#### NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 255 (1996) Surface Burning Characteristics of Building Materials

## UNDERWRITERS LABORATORIES INC. (UL)

UL 723

(1996) Surface Burning Characteristics of Building  
Materials

### 1.2 QUALITY ASSURANCE

Provide new field-applied insulation for heating, ventilating, and cooling (HVAC) air distribution systems and piping systems which are located within, on, under, and adjacent to buildings; and for plumbing systems.

#### 1.2.1 Calculation of Insulation Thickness (for alternate materials)

Calculation of insulation thickness for alternate insulation materials shall be performed by designer and certified by professional engineer who is currently licensed in any State or Washington D.C. Specific insulation thickness for services shall be indicated in Contractor's bid documents.

#### 1.2.2 Packaging and Labeling

Every package or standard container of insulation, jackets, cements, adhesives, and coatings delivered to project site shall have manufacturer's stamp or label attached giving name of manufacturer, brand and description of material. Insulation packages and containers shall be asbestos-free.

#### 1.2.3 Surface Burning Characteristics

Materials shall have a flame-spread rating of not more than 25 and a smoke-developed rating of not more than 50, when tested in accordance with NFPA 255, ASTM E 84 or UL 723. Insulation materials located exterior to the building perimeter are not required to be fire-rated.

### 1.3 SUBMITTALS

1.3.1 Submit the following in accordance with Section 01330, "Submittal Procedures".

#### 1.3.2 SD-01, Product Data

- a. Accessory materials
- b. Adhesives, sealants, and coating compounds
- c. Duct insulation
- d. Duct insulation and jackets
- e. Piping insulation and jackets.

## PART 2 - PRODUCTS

### 2.1 PIPING INSULATION

Insulation material shall conform to Table 1. Insulation thickness shall be as listed in Table 2. Except for flexible cellular insulation, insulation thickness as specified in Table 2 shall be 1/2 inch greater for insulated piping systems located outside. In lieu of Table 2, minimum thickness may be calculated in

accordance with Table 2A excerpted from ASHRAE 90.2 ASHRAE 90.1, Section 9, Table 91 and Equation 9-1. Insulation exterior shall be factory cleanable, grease resistant, non-flaking and non-peeling.

### 2.1.1 Piping Insulation Jackets

#### 2.1.1.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire retardant jacket with or without integral vapor barrier as required by the service. Provide jackets in exposed locations with a white surface suitable for field painting.

#### 2.1.1.2 Metal Jackets

a. Aluminum Jackets: ASTM B 209M ASTM B 209, Temper H14, minimum thickness of 27 gage (0.41 =0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gage (.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Provide factory prefabricated stainless steel covers for insulation on fittings, valves, and flanges. Covers shall be same thickness and material as jackets on adjacent piping.

## 2.2 HEATING, VENTILATING, AND AIR CONDITIONING SYSTEMS INSULATION

### 2.2.1 Duct Insulation

Provide factory-applied insulation with insulation manufacturer's standard reinforced fire-retardant vapor barrier jacket , with identification of installed thermal resistance (R) value and out-of-package R value.

#### 2.2.1.1 Rigid Insulation

Rigid mineral fiber in accordance with ASTM C 612, Class 2 (maximum surface temperature (400 degrees F),) 3 pcf average, one and 1.50 inches thick. Alternately, minimum thickness may be calculated in accordance with ASHRAE 90.2 ASHRAE 90.1.

#### 2.2.1.2 Blanket Insulation

Blanket flexible mineral fiber insulation conforming to ASTM C 553, Type 1, Class B-3, 3/4 pound per cubic foot (pcf) nominal, 2.0 inches thick. Alternately, minimum thickness may be calculated in accordance with ASHRAE 90.2 ASHRAE 90.1.

## 2.2.2 Duct Insulation Jackets

### 2.2.2.1 All-Purpose Jacket

Provide insulation with insulation manufacturer's standard reinforced fire-retardant jacket with or without integral vapor barrier as required by the service. In exposed locations, provide jacket with a white surface suitable for field painting.

#### 2.2.2.2 Metal Jackets (for roof mounted ductwork)

a. Aluminum Jackets: ASTM B 209M ASTM B 209, Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside dimension 8 inches and larger. Provide corrugated surface jackets for jacket outside dimension 8 inches and larger. Provide stainless steel bands, minimum width of 0.5 inch.

b. Stainless Steel Jackets: ASTM A 167 or ASTM A 240/A 240M; Type 304, minimum thickness of 33 gage (0.010 inch), smooth surface with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide stainless steel bands, minimum width of 0.5 inch. Mineral fiber insulation conforming to ASTM C 533 shall be Class B-3 which is good for temperatures up to 400 degrees F.

## 2.3 ADHESIVES, SEALANTS, AND COATING COMPOUNDS

### 2.3.1 Insulation and Vapor Barrier Adhesive

Provide ASTM C 916, Type I adhesive for securing insulation to metal surfaces and for vapor barrier lap only in building interior.

### 2.3.2 Mineral Fiber Insulation Cement

ASTM C 195.

### 2.3.3 Vapor Barrier Coating

Provide in accordance with insulation manufacturers' recommendations.

### 2.3.4 Weatherproof Coating

For outside applications provide in accordance with insulation and jacket manufacturer's recommendations.

## 2.4 ACCESSORY MATERIALS

### 2.4.1 Staples

ASTM A 167, Type 304 or 316 stainless steel outside-clinch type.

### 2.4.2 Insulation Bands

1/2 inch wide; 26 gage stainless steel.

#### 2.4.3 Metal Bands

3/8 inch minimum width; 26 gage stainless steel or 24 gage aluminum.

#### 2.4.4 Anchor Pins and Speed Washers

Provide in accordance with insulation manufacturer's recommendations.

#### 2.4.5 Fibrous Glass Cloth and Tape

Fibrous glass cloth and tape; 20 by 20 maximum size mesh. Tape shall be 4 inch wide rolls. Class 3 tape shall be 4.5 ounces per square yard. In lieu of glass cloth and tape, open weave glass membrane may be provided.

#### 2.4.6 Wire

Soft annealed stainless steel, 16 gage.

#### 2.4.7 PVC Pipe Fitting Cover and Its Vapor Barrier Tape

Provide PVC fitting covers with insulation inserts of same material and thickness as pipe insulation.

#### 2.4.8 Vapor Barrier Materials

ASTM C 1136. Resistant to flame, moisture penetration, and mold growth, color white.

### PART 3 - EXECUTION

#### 3.1 PREPARATION

Clean and test mechanical systems prior to application of insulation. Obtain Contracting Officer's written approval of HVAC, water distribution systems, and air distribution systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field-applied insulation to mechanical systems. Do not insulate the following:

- a. Adjacent insulation;
- b. ASME stamps;
- c. Access plates of fan housings
- d. Cleanouts or hand-holes;
- e. Components within factory pre-insulated HVAC equipment;
- f. Factory pre-insulated flexible ductwork;
- g. Factory pre-insulated HVAC equipment;
- h. Manufacturer's nameplates;
- i. Vibration isolating connections;

### 3.2 DUCTWORK, PLENUMS, CASINGS, AND ACCESSORIES INSULATION

Provide rigid type duct insulation in mechanical chase and on roof, and where indicated; provide blanket type insulation in all other locations. Provide field-applied insulation to exterior of supply ducts.

#### 3.2.1 Rigid Insulation

Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches o.c. and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Apply insulation with joints tightly butted. Neatly bevel insulation around name plates and access plates and doors. Each pin or anchor shall be capable of supporting a 20 pound load. Cut off protruding ends of pins, after clips are sealed with coating compound for inside work or manufacturer's recommended weatherproof coating for outside work, and reinforced with open weave glass membrane.

#### 3.2.2 Flexible Blanket Insulation

Apply insulation with joints tightly butted. Secure insulation to ductwork with adhesive in 6 inch wide strips on 12 inch centers. Staple laps of jacket with outward clinching staples on 4 inch centers. Sealing shall be in accordance with paragraph entitled "Insulation Finishes and Joint Sealing." Provide pins, washers and clips at 18 inches on center and not more than 4 inches from duct edge for duct surfaces greater than 24 inches across except for top surfaces of horizontal ducts. For vertical ducts with surfaces less than 24 inches across, provide pins no more than 4 inches from duct edge at 18 inches on center. Carry insulation over standing seams and trapeze-type hangers. Install speed washers with pins and pin trimmed to washer. Sagging of flexible duct insulation shall not be permitted. Cut off protruding ends of pins after securing and sealing clips with coating compound for inside work. For warm air ducts, overlap insulation not less than 2 inches at joints and secure laps with outward clinch staples on 4 inch centers. In cold air ducts, vapor seal joints and staple as specified.

#### 3.2.3 Metal Jackets for Ductwork Outside Building

Ensure longitudinal and Circumferential joints overlap at least 2 inches wide, with filed-cut edge of Circumferential joint turned under one inch to provide smooth edge. Place longitudinal joints to shed water. Seal joints with insulation manufacturer's recommended weatherproof coating. Secure jackets in place with aluminum or stainless steel bands on 9 inch centers. Do not use dissimilar metals for direct duct connections. Where metal jacket abuts an un-insulated surface, seal joints with a weatherproof mastic recommended by insulation manufacturer. For rectangular ducts, provide corner angles to exposed corners of insulation. Apply two coats of weatherproof coating recommended by insulation manufacturer to entire surface with a layer of glass cloth embedded between coats. Ensure glass cloth overlaps not less than 2 inches at joints and adjoining surface. Each coat of weatherproof coating shall be 1/16 inch minimum thickness.

#### 3.2.4 Duct Sleeves and Pipe Sleeves

Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems. Extend surface finishes to protect surfaces, ends, and raw edges of insulation. Apply coatings and adhesives at manufacturer's recommended coverage per liter gallon.

### 3.2.5 Access Plates and Doors

On acoustically lined ducts, plenums, and casings, provide insulation on access plates and doors. On externally insulated ducts, plenums, and casings, bevel insulation around access plates and doors.

### 3.2.6 Insulation Finishes and Joint Sealing

Fill breaks, punctures, and voids with vapor barrier coating compound for inside work or manufacturer's recommended weatherproof coating for outside work. Vapor seal joints by embedding a single layer of 3 inch wide open weave glass membrane, maximum 20 by 20 mesh per linear one inch between two 1/16 inch wet film thickness coats of vapor barrier coating compound. Draw glass fabric smooth and tight with a 1 1/2 inch overlap. At jacket penetrations such as hangers, thermometers, and damper operating rods, fill voids in insulation with vapor barrier coating. Brush a coat of vapor barrier coating where required on HVAC ducts. Provide vapor barrier jacket continuous across seams, reinforcements, and projections. Where height of projections is greater than insulation thickness, carry insulation and jacket over projection.

## 3.3 PIPE INSULATION

### 3.3.1 Pipe Insulation (Except Cellular and Calcium Silicate Insulation)

Place sections of insulation around pipe and joints tightly butted into place. Draw jacket tight and smooth. Secure jacket with fire resistant adhesive, factory-applied self-sealing lap, or stainless steel outward clinching staples spaced not over 4 inches on center (o.c.) and 1/2 inch minimum from edge of lap. Cover circumferential joints with butt strips, not less than 3 inches wide, of material identical to jacket material. Overlap longitudinal laps of jacket material not less than inches. Adhesive used to secure butt strip shall be same as that used to secure jacket laps. Apply staples to both edges of butt strips.

### 3.3.2 Moisture Seal

a. Vapor Barrier Jacket: When a vapor barrier jacket is required, as indicated in Table 1, on ends of sections of insulation that butt against flanges, unions, valves, fittings, and joints, provide a vapor barrier coating or manufacturer's weatherproof coating for outside service unless pipe is supplied with factory-applied self-seal lap. Apply vapor barrier coating at longitudinal and circumferential laps. Patch damaged jacket material by wrapping a strip of jacket material around the pipe and cementing, stapling, and coating as specified for butt strips. Extend patch not less than 1 1/2 inches past the break in both directions. At penetrations by pressure gages and thermometers, fill voids with vapor barrier coating for outside service. Seal with a brush coat of the same coating.

### 3.3.3 Hangers and Anchors

Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by insulation, provide galvanized steel shields and protection saddles. Where shields are used on pipes 2 inches and larger, provide insulation inserts at points of hangers and supports. Insulation inserts shall be of calcium silicate, cellular glass, minimum 8 pcf, molded glass fiber, minimum 8 pcf, or other approved material of the same thickness as adjacent insulation. Insulation inserts shall cover bottom half of pipe circumference and be not less in length than the protection shield. Vapor-barrier facing of insert shall be of same material as facing on adjacent insulation. Seal inserts into insulation with vapor barrier coating or weatherproof coating as applicable. Where protection saddles are used, fill voids with same insulation material as used on adjacent pipe.

### 3.3.4 Flanges, Unions, Valves and Fittings for Piping

Provide insulation for cold piping and hot piping of 110 degrees F or higher. Factory fabricated removable and reusable insulation covers may be used except with flexible cellular. When nesting size insulation is used, overlap 2 inches or one pipe diameter, whichever is larger. Use insulating cement to fill voids. On pipe sizes larger than 2 1/2 inches, elbows insulated using segments shall not have less than three segments per elbow. Place and joint segments with manufacturer's recommended water-vapor resistant, fire retardant, and adhesive appropriate for the temperature limit of the service. Overlap tape seams one inch. Extend adhesive onto adjoining insulation not less than two inches. Total dry film thickness shall not be less than 1/16 inch. Where unions are indicated not to be insulated, taper insulation to union at a 45 degree angle. Provide finish coating as follows:

a. Coating with Embedded Glass Tape: Coat insulation and all purpose jacket with two coats of lagging adhesive and with glass tape embedded between coats. Total dry film thickness shall not be less than 1/16 inch. Where unions are indicated not to be insulated, taper insulation to union at a 45 degree angle. For cold piping, seal insulation and jacket with two coats of vapor barrier coating with glass tape embedded between coats. Insulate anchors attached directly to cold pipe for a sufficient distance to prevent condensation but not less than 6 inches from insulation surface.

b. PVC Fitting Covers: Factory pre-molded one-piece PVC fitting covers may be provided in lieu of two coats of adhesive with tape embedded between coats. Provide factory pre-molded field-fabricated segment or blanket insert insulation under fitting covers. Install factory pre-molded one-piece PVC fitting covers over insulation. Secure covers with stapling, taping with PVC vapor barrier tape, or with metal or plastic tacks made for securing PVC fitting covers. Do not provide PVC fitting covers where exposed to weather. Provide PVC fitting covers only in ambient temperatures below 150 degrees F.

## 3.4 FIELD QUALITY CONTROL

Visually inspect to ensure that materials provided conform to specifications. Inspect installations progressively for compliance with requirements.

### 3.4.1 Air Distribution Systems

Obtain Contracting Officer's written approval of systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field insulation to air distribution systems.

### 3.4.2 Piping Systems

Obtain Contracting Officer's written approval of HVAC water distribution systems under Section 15950, "HVAC Testing/Adjusting/Balancing" before applying field-applied insulation to HVAC water distribution systems. At Contractor's option and with Contracting officer's written approval, piping systems may be insulated before systems are tested, adjusted, and balanced (TAB'd). Piping insulation shall terminate immediately adjacent to each flow control valve, automatic control valve, or device.

TABLE 1

Insulation Material For Piping Service Material	Spec.	Type Barrier Required	Vapor
Hot Domestic Mineral Fiber	ASTM C 547		No
Water Supply and Polyolefin Re-circulating.	ASTM C 534		No
Piping (Maximum 100 deg. F) Polyolefin	ASTM C 547		No
Cold Domestic Mineral Fiber	ASTM C 547	1	Yes
Heating Piping Heating Hot. Mineral Fiber	ASTM C 547	2	No
Water (Supply & Return, Maximum 180 degrees F) Polyolefin	ASTM C 534	2	
Drinking Mineral Fiber	ASTM C 547	1	Yes
Fountain, Drain Flexible Cellular Piping(to sewer tie in)	ASTM C 534		No
Exposed Lavatory Flexible Cell Drains, Exposed Domestic Water	ASTM C 534		No
Piping & Drains to Areas for Handicap Personnel			
Horizontal Roof Mineral Fiber	ASTM C 547	1	Yes
Drain Leaders Flexible Cellular (Including Underside of Drain Body)	ASTM C 534	1	No

TABLE 2

Piping Insulation Thickness (inch)	Size (inches)		
Tube And Pipe Size (Inches)	1/4-1 1/4	1 1/2-3	3 1/2-5
Service Material			
Hot Domestic Mineral Fiber	1	1	
Water Supply and Polyolefin Re-circulating Piping (Maximum 140oF)	.5	.5	
Cold Domestic Mineral Fiber	0.75	1	1
Water Piping Cellular Glass	1.5	1.5	1.5
Service Flexible cellular	0.5	0.5	0.5
Heating Hot Water Mineral Fiber (Supply & Return Flexible cellular 180oF) Maximum	1.5	1.5	2
Exposed Lavatory Flexible cellular	1.0	1.0	1.0
	0.5	0.5	0.5

Drains, Exposed  
 Domestic Water  
 Piping & Drains  
 to Areas for  
 Handicap Personnel

Horizontal Roof Mineral Fiber	1	1	1.5
Drain Leaders Flexible Cellular (including Underside of Roof Drain Fitting)	0.50	0.50	1.0

TABLE 3

Insulation Materials for Equipment

Equipment	Spec	Type	Class
Flexible Mineral Fiber Surface Temperatures up to 400°F	ASTM C 553	I	B-3
Flexible Cellular Service Temperature from 20°F to 210°F	ASTM C 534	I	

TABLE 4

Insulation Thickness for Equipment

Equipment	Required	Thickness
Air Separators (Heating Water)		1-1/2"
Hot Water Duct-Mounted Coils		1-1/2"

END OF SECTION