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StandardSpecification for Stainless Steel Jacketing for Insulation[1]

This standard is issued under the fixed designation C1767; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

1. Scope

1.1 This specification covers stainless steel jacketing for thermal, acoustical, and fire protective insulation operating at either above or below ambient temperatures and in both indoor and outdoor locations. It does not cover insulation jacketing made from other materials such as mastics, fiber reinforced plastic, PVC, aluminum, or coated carbon steel (for example, aluminum-zinc, galvanized steel, or aluminized steel) nor does it cover the details of thermal, acoustical, or fire protective insulation systems.

1.2 While not intended to cover use inside the containment buildings of nuclear power plants, this standard does not preclude use of Class E material which does not have a moisture barrier in this containment building application.

1.3 This specification provides physical requirements for stainless steel jacketing for thermal and acoustical insulation. Guide C1423 provides guidance in selecting jacketing materials and their safe use.

1.4 This is a material specification and does not imply any performance of the installed system using the materials specified herein. For information about installation of stainless steel jacketing, see (1).[2]

1.5 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

A167 Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

A240/A240M Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications

A480/A480M Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip

C168 Terminology Relating to Thermal Insulation

C450 Practice for Fabrication of Thermal Insulating Fitting Covers for NPS Piping, and Vessel Lagging

C585 Practice for Inner and Outer Diameters of Thermal Insulation for Nominal Sizes of Pipe and Tubing

C835 Test Method for Total Hemispherical Emittance of Surfaces up to 1400°C

C1371 Test Method for Determination of Emittance of Materials Near Room Temperature Using Portable Emissometers

C1423 Guide for Selecting Jacketing Materials for Thermal Insulation

C1729 Specification for Aluminum Jacketing for Insulation

E84 Test Method for Surface Burning Characteristics of Building Materials

F1249 Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor

3. Terminology

3.1 *Definitions*—Definitions in Terminology C168 apply to terms used in this specification.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *box rib*—stainless steel sheet formed to have alternating parallel grooves and ridges with a cross section approximating a square wave.

[1] This test method is under the jurisdiction of ASTM Committee C16 on Thermal Insulation and is the direct responsibility of Subcommittee C16.40 on Insulation Systems.

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[2] The boldface numbers in parentheses refer to the list of references at the end of this standard.

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

3.2.2 *cladding (as related to insulation jacketing)*—synonymous with jacketing.

3.2.2.1 *Discussion*—The three terms "jacketing", "lagging", and "cladding" are considered synonymous in most applications and geographies. However, in some cases in the power industry in North America the term "lagging" has a different meaning than "jacketing" or "cladding" and refers specifically to a heavier gauge of jacketing.

3.2.3 *crevice corrosion*—a type of corrosion occurring on metal jacketing caused by differences in oxygen concentration in the electrolyte in adjacent regions of the material.

3.2.3.1 *Discussion*—These differences lead to a concentration cell and the oxygen starved region on the metal jacketing is subject to corrosion.

3.2.4 *cross crimped*—synonymous with 3⁄16 in. corrugated.

3.2.5 *deep corrugated*—stainless steel sheet formed to have alternating parallel grooves and ridges with a cross section approximating a sine wave.

3.2.6 *gore*—jacketing for elbows, fittings, or other non-straight portions of the piping system made from a multitude of similar overlapping pieces.

3.2.7 *lagging (as related to insulation jacketing)*—synonymous with jacketing.

3.2.7.1 *Discussion*—The three terms "jacketing", "lagging", and "cladding" are considered synonymous in most applications and geographies. However, in some cases in the power industry in North America the term "lagging" has a different meaning than "jacketing" or "cladding" and refers specifically to a heavier gauge of jacketing.

3.2.8 *mill finish*—the appearance of the stainless steel surface as supplied from the metal mill.

3.2.9 *moisture retarder (moister barrier)*—a layer of plastic film or other material applied to the inner side of metal jacketing to inhibit jacket corrosion by interfering with the formation of a galvanic cell between the dissimilar metals of the pipe and jacket or by preventing crevice corrosion.

3.2.9.1 *Discussion*—A moisture retarder is not an insulation system water vapor retarder and does not perform the same function.

3.2.10 *polykraft*—a multilayer composite film used as a moisture retarder on metal jacketing consisting of at least one layer of minimum 40 lb Kraft paper and one or more layers of plastic film, usually polyethylene at a minimum thickness of 1.5 mils.

3.2.10.1 *Discussion*—Kraft paper is commonly referred to by its basis weight which is the mass per area in units of lbs/3000 ft^2. In Metric units, this mass per area is called the grammage and is in units of g/m^2. 40 lb Kraft has a basis weight of 40 lbs/3000 ft^2 and a grammage of 65 g/m^2.

3.2.11 *polysurlyn*—a multilayer film used as a moisture retarder on metal jacketing consisting of at least one layer of ethylene/methacrylic acid copolymer and one or more layers of other polymers, usually polyethylene.

3.2.12 *splice roll*—metal jacketing sold in roll form where the package contains two separate pieces of metal jacketing rolled approximately end to end.

3.2.12.1 *Discussion*—A splice roll occurs when the metal coil being used to form the roll jacketing reaches its end before the required roll length is obtained.

3.2.13 *split roll*—synonymous with splice roll.

3.2.14 *surface finish (as related to insulation jacketing)*—the final texture of the stainless steel jacketing surface.

4. Significance and Use

4.1 This specification is used to specify material by physical property requirements that address the prerequisites in Sections 6 to 10. The designer of an insulation system, after determining the system requirements, shall use this specification to specify the appropriate stainless steel jacketing.

5. Classification

5.1 Classification of stainless steel jacketing is based on three factors:

5.1.1 *Outer Surface Treatment and Emittance (ε):*

5.1.1.1 Type I = Bare surface, ε = 0.3

5.1.2 *Alloy and Temper per Specification A240/A240M:*

5.1.2.1 Grade 1 = Alloy T-304/T-304L, annealed temper

5.1.2.2 Grade 2 = Alloy T-316/T-316L, annealed temper

NOTE 1—The "L" in the alloy is an indication of low carbon content. Since the low carbon alloy will avoid corrosion problems caused by welding, a low carbon alloy is required on those rare occasions when the stainless steel jacketing will be subjected to direct welding or the heat from welding nearby metal. The low carbon and standard alloys are considered interchangeable for use as insulation jacketing.

5.1.3 *Moisture Retarder:*

5.1.3.1 Class A = polysurlyn, 3 mil thick

5.1.3.2 Class C = polykraft per section 3.2.10

5.1.3.3 Class E = no moisture retarder

NOTE 2—Classes B & D are omitted to maintain consistency with the similar standard for aluminum jacketing, Specification C1729.

6. Materials and Manufacture

6.1 Stainless steel jacketing materials are composed of a single material or a lamination of several components. The materials are supplied in the form of rolls or sheets or preformed to fit the surface to which they are to be applied. The materials are applied in the field or as a factory-applied composite with the insulation.

6.2 Material shall be stainless steel with a mill finish of either 2B or 2D per Specification A240/A240M unless an alternative finish is agreed to by both buyer and seller.

6.3 Material shall be stainless steel and shall have a surface finish that is smooth, 3⁄16 in. corrugated, or stucco embossed. The dimensions of corrugations (pitch and depth) must be agreed to by manufacturer and purchaser to achieve interchangeability, constant rigidity, and appearance.

6.4 In most cases, the inner surface of stainless steel jacketing material is coated or covered with a moisture resistant film to retard possible galvanic or chemical corrosion, or both, of the jacketing and underlying pipe or equipment.

6.5 The stainless steel used in this jacketing shall comply with the general, chemical composition, and mechanical property requirements of Specification A240/A240M—alloys

T-304, T-304L, T-316, or T316L with annealed temper—Grades 1 or 2 per 5.1.2.

NOTE 3—In some cases, compliance to Specification A480/A480M is requested for stainless steel jacketing. Specification A240/A240M requires compliance to a number of general requirements contained within A480/A480M and additionally has requirements for chemical composition and mechanical properties so it is preferred and more thorough to require compliance with Specification A240/A240M.

NOTE 4—In some cases, compliance to Specification A167 is requested for stainless steel jacketing. Specification A167-99(2009) contains the following: "*Grades that were previously covered in both Specifications A167 and A240/A240M have been removed from this specification and may now be supplied and purchased in compliance with Specification A240/A240M. The chemical and mechanical property requirements of these grades were identical in Specifications A167 and A240/A240M at the time of removal from Specification A167.*" Since the grades used for stainless steel jacketing have effectively been transferred to and are now contained in A240/A240M, it is correct and preferred to require compliance with A240/A240M.

6.6 Stainless steel jacketing shall be specified by the thickness which shall be in the range from 0.010 to 0.050 in. (0.25 to 1.25 mm) with the exception of 3⁄16 in. corrugated stainless steel which shall not be specified at greater than 0.024 in. (0.6 mm) thickness. Stainless steel jacketing of thickness greater than 0.032 in. (0.8 mm) is typically used only to provide the mass required in some acoustic jacketing.

NOTE 5—The thickness values mentioned in sections 6.6, 6.7, and 6.8 are nominal thickness. The tolerances shown in Table 3 apply to these listed nominal values.

6.7 Box rib stainless steel jacketing pieces shall be 0.020 (0.5 mm), 0.024 (0.6 mm) or 0.032 in. (0.8 mm) thick, with a stucco embossed finish.

NOTE 6—Typical box rib widths available are 38.5 in. (978 mm) and 27.5 in. (699 mm). Typical lengths available are 8, 10, and 12 ft (2.4, 3.0, and 3.7 m). The pattern of grooves and ridges typically repeats on 4 in. (102 mm) centers and the height of each rib is typically 1 in. (25 mm).

6.8 Deep corrugated stainless steel jacketing pieces shall be 0.010 in. (0.25 mm), 0.016 in. (0.4 mm), 0.020 in. (0.5 mm), or 0.024 in. (0.6 mm) thick.

NOTE 7—Typical deep corrugated width is 33 in. (838 mm) and typical length is 6 to 12 ft (1.8 to 3.7 m). Two nominal repeating patterns are common: 1-1⁄4 in. (32 mm) on centers with a 1⁄4 in. (6 mm) height and a 2-1⁄2 in. (64 mm) on centers with a 5⁄8 in. (16 mm) height. For specific repeating pattern distances, the manufacturer shall be consulted.

7. Physical Properties

7.1 Required physical properties are shown in Tables 1 and 2.

7.2 All stainless steel jacketing shall demonstrate a flame spread index of 25 or less and smoke developed index of 50 or less when tested with the outer side (the side opposite that contacting the insulation) exposed to the flames in accordance with 11.2.

TABLE 1 Minimum Thickness for Pipe Jacketing

Nominal Outer Insulation Diameter (in.)	Minimum Allowable Stainless Steel Nominal[A] Thickness inches (mm)
≤ 8	0.010 (0.25)
over 8 thru 11	0.010 (0.25)
over 11 thru 24	0.010 (0.25)
over 24 thru 36	0.016 (0.4)
over 36	0.020 (0.5)

[A] The minimum thickness values in this table are the minimum nominal thickness permitted. The tolerances shown in Table 3 still apply to the minimum nominal values in this table.

TABLE 2 Physical Properties

Type Grade	I All		
Class	A	C	E
Emittance	0.3	0.3	0.3
Surface Burning (flame/smoke)	≤ 25/50	≤ 25/50	≤ 25/50
Moisture retarder pinholes (per 50 ft^2)	≤ 5	≤ 5	n.a.
Moisture retarder WVTR (g/100 in.^{2}/day)	≤ 0.1	≤ 1.1	n.a.

TABLE 3 Permissible Thickness Tolerances

Nominal thickness inches (mm)	Thickness tolerance in in. (mm) for	
	Up to 39.4 in. (1 m) wide jacketing and deep corrugated sheet	48 in. (1.22 m) wide jacketing and box rib sheet
≤ to 0.012 (≤ to 0.30)	± 0.0010 (± 0.0254)	± 0.0015 (± 0.0381)
>0.012 and ≤ 0.016 (>0.30 and ≤ 0.40)	± 0.0015 (± 0.0381)	± 0.0015 (± 0.0381)
>0.016 and ≤ 0.020 (>0.40 and ≤ 0.50)	± 0.0015 (± 0.0381)	± 0.0015 (± 0.0381)
>0.020 and ≤ 0.024 (>0.50 and ≤ 0.60)	± 0.0020 (± 0.0508)	± 0.0020 (± 0.0508)
>0.024 and ≤ 0.032 (>0.60 and ≤ 0.80)	± 0.0020 (± 0.0508)	± 0.0020 (± 0.0508)
>0.032 and ≤ 0.040 (>0.80 and ≤ 1.0)	± 0.0025 (± 0.0635)	± 0.0025 (± 0.0635)
>0.040 and ≤ 0.050 (>1.0 and ≤ 1.25)	± 0.0030 (± 0.0762)	± 0.0030 (± 0.0762)

7.3 Unless otherwise specified by the manufacturer, the emittance of the jacketing shall be considered to be:

7.3.1 Type I = 0.3 which is typical for a normally dull stainless steel jacket in service.

NOTE 8—Values reported in the literature for the emittance of stainless steel range from 0.2 to 0.8 depending on degree of polishing and oxidation of the surface **(2-6)**. Stainless steel jacketing is smooth but not highly polished and develops some oxidation in service. The insulation industry has had historical success using a fairly conservative emittance value of 0.3 for "in-service" stainless steel jacketing. Section 7.3 addresses the situation where a user of this standard wishes to consider a different emittance value.

7.4 Permissible thickness tolerances vary with nominal thickness and are shown in Table 3. Thickness is measured per 11.3.

7.5 Requirements for permissible pinholes in the moisture retarder when tested per 11.4 are shown in Table 2.

7.6 The moisture retarder shall have no visual defect that will affect performance and shall be free of laminated separations, holes, rips, tears, scratches, dents, non-uniform edges, or creases.