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Standard Specification for Aluminum Jacketing for Insulation[1]

This standard is issued under the fixed designation C1729; 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 aluminum jacketing for thermal and acoustical 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, or stainless steel nor does it cover the details of thermal or acoustical insulation systems.

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

1.3 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 aluminum jacketing, see (**1**).[2]

1.4 The values stated in inch-pound units are to be regarded as standard. No other units of measurement are included in this standard.

NOTE 1—A version of this specification in SI units is available as Specification C1729M.

1.5 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.6 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

B209 Specification for Aluminum and Aluminum-Alloy Sheet and Plate
B487 Test Method for Measurement of Metal and Oxide Coating Thickness by Microscopical Examination of Cross Section
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

[1] This specification 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 a 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.

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
C1729M Specification for Aluminum Jacketing for Insulation
C1785 Test Method for Concentration of Pinhole Detections in Moisture Barriers on Metal Jacketing
D3363 Test Method for Film Hardness by Pencil Test
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

2.2 *AAMA Standard:*[4]

AAMA 2605 Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix)

2.3 *ANSI Standard:*[5]

ANSI H35.2/H35.2(M) Dimensional Tolerances for Aluminum Mill Products

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*—aluminum sheet formed to have alternating parallel grooves and ridges with a cross section approximating a square wave.

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 metal jacket related 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*—localized corrosion of metal jacketing surface at, or immediately adjacent to, an area that is shielded from full exposure to the environment because of close proximity between the metal and the surface of another material.

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

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

3.2.6 *finish*—the texture of the aluminum surface.

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

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

3.2.8.1 *Discussion*—
The three terms “jacketing”, “lagging”, and “cladding” are considered synonymous in most metal jacket related 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.

3.2.9 *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.

[4] Available from American Architectural Manufacturers Association (AAMA), 1827 Walden Office Square, Suite 550, Schaumburg, IL 60173-4268, http://www.aamanet.org.
[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

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.

3.2.11 *polyfilm—in relation to metal jacketing*, a three-layer film used as a moisture retarder on metal jacketing consisting of one layer of ethylene/methacrylic acid copolymer and two layers of other polymers, usually polyethylene.

3.2.12 *PVdF based paint system*—a pigmented paint used on the outer surface of metal jacketing to provide corrosion resistance and higher emittance than bare metal consisting of a fairly thin primer paint layer covered by a thicker topcoat paint layer where the latter is a polyvinylidene fluoride (PVdF) type paint.

3.2.13 *PVF film*—a polymer film consisting of polyvinyl fluoride used on the outer surface of metal jacketing to provide corrosion resistance and higher emittance than bare metal.

3.2.14 *safety edge*—an edge of metal jacketing that has been de-burred or rounded by a rolling operation.

3.2.15 *safety hem*—a rounded edge of metal jacketing created by folding the edge of sheet jacketing completely back upon itself using a roll former or a brake.

3.2.15.1 *Discussion*—

The fold is typically made toward the underside of the jacketing so that the original edge is hidden and the external appearance of the jacketing is preserved.

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

3.2.16.1 *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.

3.2.17 *split roll*—synonymous with splice roll.

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 aluminum jacketing.

5. Classification

5.1 Classification of aluminum jacketing is based on three factors:

5.1.1 *Outer surface treatment and emittance (ε):*

5.1.1.1 Type I = Bare surface, $\varepsilon \geq 0.1$,

5.1.1.2 Type II = Painted with pigmented paint, $\varepsilon \geq 0.8$,

5.1.1.3 Type III = Painted with unpigmented paint, $\varepsilon \geq 0.5$,

5.1.1.4 Type IV = Plastic film coated surface, $\varepsilon \geq 0.85$, and

5.1.1.5 Type V = Painted with a PVdF based paint system, $\varepsilon \geq 0.8$.

5.1.1.6 PVF film is one kind of plastic film used in Type IV.

5.1.1.7 Paint systems for Types II and III must be factory applied and baked on.

5.1.1.8 Plastic film for Type IV must be factory applied and heat laminated to the surface.

5.1.2 *Alloy and Temper per Specification B209:*

5.1.2.1 Grade 1 = Alloy 3105 or 3003, half hard temper (H14 or H24)

5.1.2.2 Grade 2 = Alloy 3105 or 3003, quarter hard temper (H12 - lock forming quality),

5.1.2.3 Grade 3 = Alloy 1100, dead soft temper,

5.1.2.4 Grade 4 = Alloy 3004,

5.1.2.5 Grade 5 = Alloy Alclad 3004 (alloy 3004 clad both sides with alloy 7072 for improved corrosion resistance), and

5.1.2.6 Grade 6 = Alloy 5052.

5.1.3 *Moisture Retarder:*

5.1.3.1 Class A = polyfilm, 3 mil thick,

5.1.3.2 Class C = polykraft per section 3.2.10,

5.1.3.3 Class D = painted, and

5.1.3.4 Class E = no moisture retarder.

NOTE 2—Class B was removed in 2011 because it was not used or produced. The remaining Classes were not renumbered to avoid conflicts with engineering specifications that reference the remaining Classes.

6. Materials and Manufacture

6.1 Aluminum 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 The primary material shall be aluminum and shall have a 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.

6.3 When agreed upon by purchaser and seller, aluminum sheets used as pipe insulation jacketing (see 8.2) shall have a safety edge or a 3⁄8 to 1⁄2 in. safety hem along one entire width edge of the sheet. Aluminum jacketing with a safety edge or safety hem must still meet the length dimensions specified in 8.2.1. A safety hem shall not be specified when the finish is 3⁄16 in. corrugated.

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

6.5 Polyfilm (Class A) and polykraft (Class C) must be factory applied and heat laminated to the interior surface of the metal jacketing.

6.6 For highly corrosive ambient conditions or to increase emittance, the purchaser shall specify that the outer surface of the aluminum be coated with a pigmented paint (Type II), unpigmented paint (Type III), a plastic film (Type IV), or with a PVdF based paint system (Type V).

6.7 Pigmented paint (Type II), unpigmented paint (Type III), and PVdF based paint systems (Type V) must be factory applied and baked on to the outer surface.

6.8 The topcoat of the factory applied PVdF based paint systems (Type V) must contain at least seventy percent (70 %) by weight of polyvinylidene fluoride (PVdF) resin based on the total weight of resins present and at least forty percent (40 %) by weight of PVdF resin based on the total weight of solids present in the coating composition. The full PVdF based paint system must meet the application and performance requirements of AAMA 2605.

6.9 Unless agreed to otherwise by purchaser and seller of the metal jacketing, the primer layer for Type V outer surface treatment must have a minimum dry thickness of 0.2 mils and the PVdF topcoat must have a minimum dry thickness of 0.7 mils.

NOTE 3—It is important to be aware that the minimum 0.7 mil thickness requirement in Table 1 applies to the topcoat of the Type V PVdF based paint system and not to the total outer surface paint thickness.

6.10 Plastic film (Type IV), including PVF film, must be factory applied to the metal jacketing outer surface using heat lamination with a thermally activated adhesive.

6.11 Plastic film (Type IV), including PVF film, must be a minimum of 1.5 mils thick.

6.12 The aluminum used in this jacketing, with the exception of box rib, shall be manufactured from Specification , alloys 3003, 3105, or 1100 with tempers of H14 or H24 (half hard), H12 (quarter hard), or dead soft – Grades 1, 2, or 3 per 5.1.2.

6.13 Aluminum jacketing shall be specified by the thickness of the aluminum layer which shall be in the range from 0.016 to 0.050 in.

NOTE 4—The thickness values mentioned in 6.12, 6.14, and 6.13 are nominal thickness. The tolerances shown in Table 2 apply to these listed nominal values.

6.14 The measured thickness of metal jacketing will be influenced by any forming or rolling such as that described in 10.5. All requirements for and discussion of jacketing thickness and thickness tolerance in this document including Table 3 and Table 2 apply to the base metal before any forming or rolling and do not include any coatings or films that are applied to the surface such as the moisture barriers described in 5.1.3.

TABLE 1 Physical Properties

Type	I				II and V				III				IV			
Grade	All				All				All				All			
Class	A	C	D	E	A	C	D	E	A	C	D	E	A	C	D	E
Emittance	0.1	0.1	0.1	0.1	0.8	0.8	0.8	0.8	0.5	0.5	0.5	0.5	0.85	0.85	0.85	0.85
Surface Burning (flame/ smoke max)	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50	25/50
Moisture retarder pinhole dectections (per 50 ft^2)	≤5	≤5	≤5	n.a.	≤5	≤5	≤5	n.a.	≤5	≤5	≤5	n.a.	≤5	≤5	≤5	n.a.
Moisture retarder WVTR (g/100 in2/ day)	≤0.1	≤1.1	n.a.	n.a.	≤0.1	≤1.1	n.a.	n.a.	≤0.1	≤1.1	n.a.	n.a.	≤0.1	≤1.1	n.a.	n.a.
Outer Paint Thickness (mils)	n.a.	n.a.	n.a.	n.a.	0.7-0.8	0.7-0.8	0.7-0.8	0.7-0.8	0.3-0.4	0.3-0.4	0.3-0.4	0.3-0.4	n.a.	n.a.	n.a.	n.a.
Outer Paint Pencil Hardness (min)	n.a.	n.a.	n.a	n.a.	H	H	H	H	H	H	H	H	n.a	n.a	n.a.	n.a.

TABLE 2 Permissible Thickness Tolerances

Nominal thickness in in.	Thickness tolerance in in. for	
	Up to 39.4 in. wide jacketing and deep corrugated sheet	48 in. wide jacketing and box rib sheet
over 0.010 through 0.016	±0.0010	±0.0015
over 0.016 through 0.025	±0.0015	±0.0020
over 0.025 through 0.032	±0.0020	±0.0025
over 0.032 through 0.039	±0.0020	±0.0030
over 0.039 through 0.047	±0.0025	±0.0035
over 0.047 through 0.063	±0.0030	±0.0035

TABLE 3 Minimum Thickness for Pipe Jacketing

Outer Insulation Diameter (in.)	Minimum Allowable Aluminum Thickness (in.)	
	Rigid Insulation	Non-Rigid Insulation
≤ 8	0.016	0.016
over 8 through 11	0.016	0.020
over 11 through 24	0.016	0.024
over 24 through 36	0.020	0.032
over 36	0.024	0.040

6.15 Box rib aluminum jacketing pieces shall be manufactured from Specification B209, alloys 3003 or 3105 (Grade 1), alloys 3004 or Alclad 3004 (Grades 4 and 5), or alloy 5052 (Grade 6) per Section 5.1.2 and shall be 0.032 in., 0.040 in., 0.048 in., or 0.050 in. thick.

NOTE 5—Typical box rib widths available are 45-⅝ in., 38.5 in., and 27.5 in. Typical lengths available are 8, 10, and 12 ft. The pattern of grooves and ridges typically repeats on 4 in. centers and the height of each rib is typically 1 in.

6.16 Deep corrugated aluminum jacketing pieces shall be 0.016 in., 0 .020 in., 0.024 in., 0.032 in., 0.040 in., or 0.048 in. thick.

6.16.1 Typical deep corrugated width is 33 in. and typical length is 6 to 12 ft. Two nominal repeating patterns are common – 1-¼ in. on centers with a ¼ in. height and a 2-½ in. on centers with a ½ or ⅝ in. height. For specific repeating pattern distances, the manufacturer shall be consulted.

7. Physical Properties

7.1 Required physical properties are shown in Table 3 and Table 1.

NOTE 6—See section 10.9 for further information regarding Table 3.

7.2 All aluminum jacketing shall demonstrate a flame spread of 25 or less and smoke developed of 50 or less when testing the outer side (the side opposite that contacting the insulation) in accordance with 11.2.

NOTE 7—Aluminum jacketing is not typically considered a fire resistant material. If a higher level of fire resistance or protection is required, alternative jacketing materials usually based on steel, should be considered.

7.3 Unless otherwise agreed to by purchaser and seller of the metal jacketing, the emittance of the jacketing shall be:

7.3.1 Type I ≥ 0.1 which is typical for a normally oxidized aluminum jacket in service,

7.3.2 Type II ≥ 0.8 which is typical for a pigmented paint,

7.3.3 Type III ≥ 0.5 which is typical of an unpigmented paint,

7.3.4 Type IV ≥ 0.85 which is typical of a plastic film surface, and

7.3.5 Type V ≥ 0.8 which is typical for a PVdF based paint system.

NOTE 8—Testing of the emittance of Type I has yielded initial unoxidized values ranging from 0.03 to 0.05 and oxidized "in-service" values ranging from 0.1 to 0.31 (**2, 3, 4, 5, 6**). The use of an emittance of 0.1 is recommended here as being the most conservative value. 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 2. Thickness is measured per 11.3.

7.5 Requirements for permissible pinhole detections in the moisture retarder when tested per Test Method C1785 are shown in Table 1.

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.

7.7 Requirements for water vapor transmission rate (WVTR) of the moisture retarders tested per 11.6 are shown in Table 1. Testing the WVTR of moisture retarders is not possible after they are applied to the aluminum jacketing so this testing shall be done on the moisture retarders prior to application.

8. Dimensions and Permissible Variations

8.1 Dimensions for aluminum jacketing shall be as agreed to by purchaser and seller.

8.2 When cut into sheets for use as pipe insulation jacketing, the dimension of the aluminum jacketing sheet designed to accommodate the pipe insulation circumference shall be called the length and the other major dimension shall be identified as the width.

8.2.1 The length shall be a minimum of the outer circumference of the insulation plus 2 in. for insulation outer diameter ≤ 20 in. and a minimum of the outer circumference of the insulation plus 2.5 in. for insulation outer diameter > 20 in.

8.2.2 Typical width is 36 in., 39.4 in., or 48 in.

8.2.3 Dimensions differing from these standards are possible but must be agreed to by purchaser and seller.

8.2.4 Tolerances for aluminum jacketing sheets shall be ± ⅛ in. in width and length.

8.3 When cut into sheets for use as equipment and vessel insulation jacketing, the longer dimension of the box rib or corrugated aluminum jacketing sheet shall be called the length and the other (shorter) major dimension shall be identified as the width.

8.3.1 Typical width of deep corrugated aluminum sheet is 33 in.

8.3.2 Typical lengths of deep corrugated aluminum sheet are 6 to 12 ft.

8.3.3 Typical widths of box rib aluminum sheet are 45-⅝ in., 38.5 in., and 27.5 in.

8.3.4 Typical lengths of box rib aluminum sheet are 8, 10, and 12 ft.

8.3.5 Dimensions differing from these standards are possible but must be agreed to by purchaser and seller.

8.3.6 Width and length tolerances for aluminum jacketing deep corrugated sheets and box rib shall be ± ⅛ in. within a lot and ± ½ in. between lots.

8.4 When aluminum jacketing is provided in rolls, the longer dimension is called the length and the shorter dimension is called the width.