Designation: C1729M – 17

Standard Specification for Aluminum Jacketing for Insulation[1]

This standard is issued under the fixed designation C1729M; 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 SI 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 inch-pound units is available as Specification C1729.

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 and health 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

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

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

[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.

Current edition approved May 1, 2017. Published May 2017. Originally approved in 2013. Last previous edition approved in 2016 as C1729M – 16a. DOI: 10.1520/C1729M-17.

[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.

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 4.8 mm 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.

3.2.10 *polykraft*—a multilayer composite film used as a moisture retarder on metal jacketing consisting of at least one layer of minimum 65 g/m^2 kraft paper and one or more layers of plastic film, usually polyethylene at a minimum thickness of 38 microns.

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.

[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.

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, 76 microns 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, 4.8 mm 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 10 –15 mm 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 4.8 mm 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 the 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 5 microns and the PVdF topcoat must have a minimum dry thickness of 18 microns.

NOTE 3—It is important to be aware that the minimum 18 micron 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 38 microns thick.

6.12 The aluminum used in this jacketing, with the exception of box rib, shall be manufactured from Specification B209, 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 0.4 to 1.3 mm.

NOTE 4—The thickness values mentioned in 6.13, 6.14, 6.15, and 6.16 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 2 and Table 3 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.

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 0.8 mm, 1.0 mm, 1.2 mm, or 1.3 mm thick.

NOTE 5—Typical box rib widths available are 1159 mm, 978 mm, and 699 mm. Typical lengths available are 2.44, 3.05, and 3.66 m. The pattern of grooves and ridges typically repeats on 102 mm centers and the height of each rib is typically 25 mm.

6.16 Deep corrugated aluminum jacketing pieces shall be 0.4 mm, 0.5 mm, 0.6 mm, 0.8 mm, 1.0 mm, and 1.2 mm thick.

6.16.1 Typical deep corrugated width is 838 mm and typical length is 1.81 to 3.66 m. Two nominal repeating patterns are

TABLE 1 Physical Properties

Type	I				II or 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	≤5	≤5	≤5	n.a.	≤5	≤5	≤5	n.a.	≤5	≤5	≤5	n.a.	≤5	≤5	≤5	n.a.
Moisture retarder WVTR (g/m2/day)	≤1.55	≤17	n.a.	n.a.	≤1.55	≤17	n.a.	n.a.	≤1.55	≤17	n.a.	n.a.	≤1.55	≤17	n.a.	n.a.
Outer Paint Thickness (microns)	n.a.	n.a.	n.a.	n.a.	18–20	18–20	18–20	18–20	8–10	8–10	8–10	8–10	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. (mm)	Thickness tolerance mm for	
	1 m wide jacketing and deep corrugated sheet	1.22 m wide jacketing and box rib sheet
over 0.25 through 0.40	0.025	0.038
over 0.40 through 0.64	0.038	0.051
over 0.64 through 0.8	0.051	0.064
over 0.8 through 1.0	0.051	0.076
over 1.0 through 1.2	0.064	0.089
over 1.2 through 1.6	0.076	0.089

TABLE 3 SI Equivalent Thickness for Pipe Jacketing

Jacket Thickness in Inch—Pound Units (in.)	Jacket Thickness in SI Units (mm)
0.016	0.4
0.020	0.5
0.024	0.6
0.032	0.8
0.040	1.0

common 32 mm on centers with a 6 mm height and a 64 mm on centers with a 16 mm 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 51 mm for insulation outer diameter 500 mm and a minimum of the outer circumference of the insulation plus 64 mm for insulation outer diameter 500 mm.

8.2.2 Typical width is 0.914 m, 1220 mm, or 1 m.

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 ±3 mm 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 840 mm.

8.3.2 Typical lengths of deep corrugated aluminum sheet are 1.83 to 3.66 m.

8.3.3 Typical widths of box rib aluminum sheet are 1160 mm, 980 mm, and 700 mm.

8.3.4 Typical lengths of box rib aluminum sheet are 2.44 m, 3.05 m, and 3.66 m.

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 ±3 mm within a lot and ±13 mm 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.

8.4.1 Tolerances for roll materials shall be ±3 mm on width and 152 mm, –0 mm on length. This length tolerance does not apply to splice/split rolls where the total length shall be as required by 15.2.

9. Workmanship, Finish, and Appearance

9.1 There shall be no defects in materials or workmanship that will affect the required performance of the aluminum jacketing.

9.2 There shall be no defects that adversely affect the appearance of the aluminum jacketing.

9.3 There shall be no defects that would affect the ability of the user to process the aluminum jacketing material.

10. Requirements of Aluminum Jacketing

10.1 The main purposes of aluminum jacketing are to provide physical damage resistance, UV protection, and to shed liquid water minimizing the amount entering the insulation system.

10.2 If greater levels of corrosion resistance are desired than that achieved with bare outer surface aluminum (Type I), a painted (Type II, III, or V) or plastic film coated (Type IV) aluminum shall be considered. If even greater levels of corrosion resistance are desired, use of stainless steel jacketing shall be considered.

10.3 The applications for aluminum jacketing are categorized into three areas: straight pipe, pipe elbows/fittings, and vessels/equipment. The requirements for each of these applications differ.

10.4 *Aluminum jacketing on straight pipe:*

10.4.1 At the point of application, aluminum jacketing used on straight pipe will consist of a multitude of pre-curved pieces with dimensions per 8.2.

10.4.2 The thickness (gauge) and temper used for the aluminum jacketing on straight pipe varies with jacket diameter. This section lists the aluminum jacketing thickness and Grade requirements for rigid insulation. For non-rigid insulation, see 10.9.

10.4.2.1 For straight pipe up to a jacket diameter of 610 mm, the minimum allowable thickness is 0.4 mm and Grade 1 aluminum shall be used (temper of H14 or H24 which are also called half hard).

10.4.2.2 For straight pipe with jacket diameter greater than 600 mm up to 900 mm, the minimum allowable thickness is 0.5 mm and Grade 1 aluminum shall be used (temper of H14 or H24 which are also called half hard).

10.4.2.3 For straight pipe with a jacket diameter greater than 900 mm, the minimum allowable thickness is 0.6 mm and Grade 1 aluminum shall be used (temper of H14 or H24 which are also called half hard).

10.4.3 When expected physical abuse is severe, consideration shall be given to using thickness of 0.8 mm or greater. When these thicknesses are selected, Grade 2 aluminum shall be used (temper of H12 or quarter hard).

10.4.4 Aluminum jacketing on straight pipe requires the use of a moisture retarder so only Classes A, C, or D shall be used.

10.5 *Aluminum jacketing on pipe elbow/fittings:*

10.5.1 Aluminum jacketing applied to insulation on pipe elbows/fittings shall take the form of, 2-piece (pressed), 4-piece, or gores all of which shall be pre-formed or pre-rolled to fit around the insulation. For outer insulation diameters of 500 mm or larger, the use of 8-piece sections on pipe elbows/fittings is acceptable.

10.5.1.1 For 2-piece (pressed) elbows, the overlaps at the heel and throat shall comply with the minimum values in Table 4 when the insulation outer diameter conforms to the target values in Practices C585 or C450.

NOTE 9—If the insulation outer diameter is smaller or larger than that specified in Practices C585 or C450, the heel and throat overlaps will be larger or smaller than 16 mm. With 2-piece (pressed) elbows, deviations in insulation outer diameter from that specified in Practices C585 or C450 causes, in some cases, undesirable gaps in the joint at the heel or throat.

10.5.2 Grade of aluminum jacketing used shall be either 2 or 3 (3105/3003 quarter hard or 1100 dead soft).

10.5.2.1 When Grade 2 aluminum jacketing is used, the thickness shall be 0.8 mm.

10.5.2.2 When Grade 3 aluminum jacketing is used, the thickness shall be 0.6 mm.

10.5.3 Class of aluminum jacketing used for elbows shall be either A (polyfilm, 76 microns thick on the interior surface) or D (painted moisture barrier on the interior surface).

10.5.3.1 When elbows are made from gore pieces, Class A shall be used.

10.5.3.2 When elbows are made from 2-piece, 4-piece, or 8-piece, Class A or D shall be used.

10.6 *Aluminum jacketing on equipment and vessels:*

10.6.1 Except for the thickness, finish, and Grade requirements in 10.6.2 to 10.6.4, aluminum jacketing applied to equipment and vessels shall be of any size and shape agreed upon by purchaser and seller.

10.6.2 The minimum allowable aluminum jacketing thickness shall be as listed in Table 3 with additional related information in 10.9. If the thickness is less than 0.8 mm, Grade 1 aluminum shall be used (temper of H14 or H24 which are also called half hard). If the thickness is 0.8 mm or greater, Grade 2 aluminum shall be used (temper of H12 or quarter hard).

10.6.3 For horizontal vessels, only smooth or stucco embossed finish shall be used (no deep corrugated sheet or 4.8 mm corrugated finish).

10.6.4 For vertical vessels and equipment less than 2.44 m diameter, any finish of aluminum jacketing or aluminum deep corrugated sheet is acceptable. For vertical vessels and equipment 2.44 m diameter and greater, deep corrugated aluminum sheet jacketing shall be used.

TABLE 4 Minimum Overlap at Heel and Throat of Two-piece Elbows

Insulation O.D. mm	Minimum Elbow Heel and Throat Overlap[A] mm
Up to 60	11
70 and up	16

[A] Also called the tangent.

10.7 The purchaser shall be aware that Grade 3 aluminum jacketing has relatively low resistance to denting due to the dead soft temper. Grades 1 and 2 aluminum jacketing have much greater resistance to denting due to their harder alloy and tempers compared to Grade 3.

10.8 For all applications of aluminum jacketing, the purchaser shall select the Type (outer surface treatment) to meet the required emittance and corrosion resistance.

10.9 The specifier shall be aware that non-rigid insulations with compressive strength below 103 kPa will typically require greater aluminum jacket thickness to achieve the desired damage resistance than will rigid insulations with compressive strength greater than 103 kPa. Table 3 shows minimum aluminum jacketing thicknesses for rigid and non-rigid pipe insulation.

11. Test Methods

11.1 *Total Hemispherical Emittance*—Test in accordance with Test Method C1371 or C835.

11.2 *Surface Burning Characteristics*—Test in accordance with Test Method E84.

11.3 *Metal sheet thickness*—Test in accordance with ANSI H35.2/H35.2(M).

11.4 *Pinhole Detections in Moisture Retarder*—Test in accordance with Test Method C1785.

11.4.1 *Pass Criteria:*

11.4.1.1 The moisture retarder is considered acceptable if no more than 5 pinhole detections, collectively, are detected in the 10 wetted test areas.

11.5 *Pencil Hardness*—Test in accordance with Test Method D3363.

11.6 *Water vapor transmission rate of the moisture retarder*—Test in accordance with Test Method F1249 at 23°C and 100% relative humidity with results normalized to 1 atmosphere of pressure.

11.7 *Paint or Film Thickness*—Test in accordance with Test Method B487.

12. Sampling, Inspection, and Rejection of Defective Material

12.1 A lot of material shall be considered to be the largest quantity of a specific aluminum jacketing received by the purchaser under one order, or, if so designated by the manufacturer, that quantity of products identified as the particular lot.

12.2 A unit of material shall be considered to be the smallest packaged quantity of aluminum jacketing within a lot, that is, one roll in a lot of rolls or one bundle of sheets in a lot of sheeted material.

12.3 Inspection shall consist of any tests for specification conformance the user deems necessary. Due to the impracticality of performing some tests on an inspection basis, if

deemed necessary, the user shall request certification to specific test requirements.

12.4 Incoming lots shall be sampled at a minimum rate of 5 % of units received for inspection.

12.5 If any nonconformance to specification is detected within the 5 % sample, increase sampling to 10 % of the lot.

12.6 If 50 % or more of the 10 % sampled units is determined to be defective, the lot shall be considered unacceptable.

12.7 It shall be left to the discretion of the user whether to continue sampling for acceptable material. In any case, units found defective shall be considered unacceptable and rejected.

13. Certification

13.1 When specified in the purchase order or contract, the purchaser shall be furnished certification that samples representing each lot have been either tested or inspected as directed in this specification and the requirements have been met. When specified in the purchase order or contract, a report of the results shall be furnished.

13.2 *Qualification Requirements*—The following requirements are generally designated for initial product qualification:

13.2.1 Surface emittance,

13.2.2 Surface burning characteristics, and

13.2.3 Pinhole detections in moisture retarder.

13.3 *Inspection Requirements*—The following requirements are generally designated for acceptance sampling of lots of qualified products. Any performance requirements not listed in 13.3 are considered qualification requirements:

13.3.1 Thickness,

13.3.2 Dimensions, and

13.3.3 Workmanship and appearance.

14. Product Marking

14.1 The packaged aluminum jacketing material shall bear identification including the following information:

14.1.1 Manufacturer,

14.1.2 Product designation,

14.1.3 Roll or sheet dimensions, presence of a splice/split roll per 15.2, if applicable, and

14.1.4 Lot number.

14.2 If required by the user, the packaged material shall bear a marking of conformance to this specification and classification by Type, Grade, and Class, such as: Complies with Specification C1729, Type I, Grade 1, Class A.

14.3 If required by the user, the manufacturer shall provide evidence from an independent testing laboratory of the surface burning characteristics in accordance with Test Method E84.

15. Packaging

15.1 Unless otherwise specified, the material shall be supplied in the manufacturer's standard commercial package.

15.2 The presence of a splice roll or split roll shall be marked on the packaging, an extra 1500 mm minimum of total length shall be provided in that package, and a maximum of one splice/split roll shall be allowed per pallet.

NOTE 10—There are typically 20 packages of roll jacketing per pallet so this assures a maximum of 5% of roll jacketing packages on a full pallet can contain a splice/split roll.

16. Keywords

16.1 aluminum; cladding; jacket; jacketing; lagging; moisture barrier; moisture retarder; thermal insulation

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