



Designation: B479 – 06

# Standard Specification for Annealed Aluminum and Aluminum-Alloy Foil for Flexible Barrier, Food Contact, and Other Applications<sup>1</sup>

This standard is issued under the fixed designation B479; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope\*

1.1 This specification covers annealed aluminum and aluminum-alloy foil containing 98.00 % minimum aluminum and in thicknesses 0.00025 in. (0.0064 mm) to, but not including, 0.006 in. (0.15 mm). Alloys (see **Note 1**) covered by this specification include, but are not limited to 1100, 1145, 1235, 8011, 8079, and 8111, which conform to the requirements of **6.1** and **Table 1**. Unless otherwise specified by the purchaser, the alloy to be supplied shall be left to the discretion of the producer.

1.2 The foil is for use in packaging, which includes food handling and processing applications, requiring flexible barrier materials, and other general applications. The foil may be used as supplied or laminated to other materials, such as paper or plastic films.

1.3 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see **Annex A1**.

1.4 The values stated in inch-pound units are to be regarded as the standard. The SI values in parentheses are for information only.

1.5 The following precautionary caveat pertains only to the test method portion of this specification: *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.*

NOTE 1—Throughout this specification, use of the term *alloy* in the general sense includes aluminum as well as aluminum alloy.

NOTE 2—If the alloy is specified by the purchaser, its designation shall be in accordance with ANSI H35.1. The equivalent Unified Numbering System alloy designations are those shown in **1.1** preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E527.

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.03 on Aluminum Alloy Wrought Products.

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## 2. Referenced Documents

2.1 The following documents of the date of issue in effect on date of material procurement form a part of this specification to the extent referenced herein.

### 2.2 ASTM Standards:<sup>2</sup>

B926 Method for Pinhole Determination in Aluminum and Aluminum Alloy Plain Foil by Means of a Light Table

E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys

E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition

E96/E96M Test Methods for Water Vapor Transmission of Materials

E252 Test Method for Thickness of Foil, Thin Sheet, and Film by Mass Measurement

E345 Test Methods of Tension Testing of Metallic Foil

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)<sup>3</sup>

E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis

E1251 Test Method for Analysis of Aluminum and Aluminum Alloys by Spark Atomic Emission Spectrometry

### 2.3 American National Standard:

H35.1 Alloy and Temper Designation Systems for Wrought Aluminum<sup>4</sup>

Z1.4 Sampling Procedures and Tables for Inspection by Attributes<sup>4</sup>

## 3. Terminology

### 3.1 Definitions:

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>4</sup> Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

\*A Summary of Changes section appears at the end of this standard

**TABLE 1 Chemical Composition Limits<sup>A,B,C</sup>**

Si + Fe	1.8	Ti	0.08
Cu	0.20	Others—each <sup>D</sup>	0.05 <sup>E, F</sup>
Mn	0.10	Others—total <sup>D</sup>	0.15
Mg	0.05	Al, min.	98.00 <sup>G</sup>
Zn	0.10		

<sup>A</sup> Limits are in percent maximum unless otherwise noted.

<sup>B</sup> Analysis shall be made for the elements for which limits are shown in this table.

<sup>C</sup> For purposes of determining conformance to these limits, an observed value or a calculated value obtained from analysis shall be rounded to the nearest unit in the last right-hand place or figures used in expressing the specified limit, in accordance with the rounding method of Practice E29.

<sup>D</sup> *Others* includes all unlisted metallic elements. The producer may analyze samples for trace elements not specified in the specification. However, such analysis is not required and may not cover all metallic *Others* elements. Should any analysis by the producer or the purchaser establish that an *Others* element exceeds the limit of *Each* or that the aggregate of several *Others* elements exceeds the limit of *Total*, the material shall be considered non-conforming.

<sup>E</sup> For food applications, lead, arsenic, and cadmium shall be less than 0.01 % each. For purposes of determining conformance to the limits of these three elements, an observed value or a calculated value obtained from analysis shall be considered significant, in accordance with the absolute method of Practice E29.

<sup>F</sup> Food packaging, in accordance with CONEG Model Legislation, shall have a maximum total of less than 100 ppm for the combined total of lead, mercury, cadmium, and hexavalent-chrome (Pb, Hg, Cd, and Cr<sup>6+</sup>).

<sup>G</sup> The aluminum content shall be calculated by subtracting from 100.00 % the sum of all metallic elements present in amounts of 0.010 % or more each, rounded to the nearest 0.01 % prior to determining the sum.

3.1.1 *foil*—a rolled product rectangular in cross section of thickness less than 0.006 in. (0.15 mm).

3.1.2 *matte one-side foil (MIS)*—foil with a diffuse reflecting finish (matte) on one side and a bright specular finish on the other side.

3.1.3 *bright two-sides foil (B2S)*—foil having a uniform bright specular finish on both sides.

3.1.4 *dry annealed, A*—having a test dryness 100/0, free from residual rolling oil as determined by the water test.

3.1.5 *dry annealed, B*—having a test dryness 90/10, having a slight film of residual rolling oil as determined by the water-alcohol test.

3.1.6 *dry annealed, C*—having a test dryness 80/20, having a slight film of residual rolling oil as determined by the water-alcohol test.

3.1.7 *slick annealed*—having a uniform film of residual rolling or applied oil as determined by the drop of water test.

### 3.2 Definitions of Terms Specific to This Standard:

3.2.1 *capable of*—The term *capable of* as used in this specification means that the test need not be performed by the producer of the material. However, should subsequent testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

## 4. Ordering Information

4.1 Orders for material to this specification shall include the following information:

4.1.1 This specification designation (which includes the number, the year, and the revision letter, if applicable),

4.1.2 Quantity in pieces, length (yards, metres) or weight (pounds, kilograms),

4.1.3 Nominal thickness and (a) sheet size, or (b) maximum roll diameter, nominal roll width, and core size (Section 9),

4.1.4 Surface condition (see 3.1.2 and 3.1.3),

4.1.5 Type of splice (for rolls only), (see 10.2),

4.2 Additionally, orders for material to this specification shall include the following information when required by the purchaser:

4.2.1 Whether supply of a specific alloy is required (see 1.1),

4.2.2 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to shipment,

4.2.3 Whether the intended use involves food processing, food packaging, or food preservation (see 6.1 and 14.2), and if so, what government regulations are applicable.

4.2.4 Whether certification is required (Section 12).

4.2.5 Whether special statistical methods are to be used for visual and dimensional inspection. If so, these methods shall be listed.

## 5. Responsibility for Quality Assurance

5.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract or order, the producer may use his own or any other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser at the time the order is placed. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to assure that the material conforms to prescribed requirements.

## 6. Chemical Composition

6.1 *Limits*—The foil shall conform to the chemical composition limits in Table 1. For applications involving food packaging, handling, or preservation the absolute amounts of lead, arsenic, and cadmium shall be less than 0.01 % each (see footnote E of Table 1). The producer shall determine conformance by analyzing samples taken when the ingots are poured, or when continuous sheet or plate is cast, or by analyzing samples taken from the finished or semifinished product. If the producer has determined the chemical composition during the course of manufacture, he shall not be required to sample and analyze the finished product.

6.2 *Number of Samples*—The number of samples taken for determination of chemical composition shall be as follows:

6.2.1 When samples are taken at the time the ingots are poured, at least one sample shall be taken for each group of ingots poured simultaneously from the same source of molten metal.

6.2.2 When samples are taken at the time a coil is cast, at least one sample shall be taken for each coil cast from the same source of molten metal.

6.2.3 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 4000 lb (1814 kg), or fraction thereof, in the shipment.

6.3 *Methods of Sampling*—Samples for determination of chemical composition shall be taken in accordance with one of the following methods:

6.3.1 Samples for chemical analysis shall be taken from the material by clipping a representative piece or pieces to obtain a prepared sample of not less than 75 g. Sampling shall be in accordance with Practice E55.

6.3.2 Sampling for spectrochemical analysis shall be in accordance with Practices E716. Samples for other methods of analysis shall be taken by means suitable for the form of material being analyzed and the type of analytical method used.

6.4 *Methods of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E34), or spectrochemical (Test Method E607, and E1251), methods. Other methods may be used only when no published ASTM method is available. In case of dispute, the methods of analysis shall be agreed between the producer and purchaser.

## 7. Tensile Properties

7.1 *Limits*—Tensile breaking load minimums and maximums shall be as agreed between customer and supplier. Splices shall be capable of developing 80 % of the breaking load specified for unspliced foil.

NOTE 3—Tensile breaking loads define the strength properties good quality foil is capable of meeting.

7.2 *Number of Tests*—When the tensile breaking load is to be determined not less than two samples shall be selected from a shipment with each sample from a different roll of foil.

7.3 *Test Specimens*—All the test specimens shall be taken parallel to the direction of rolling and they shall be in accordance with Type A or Type B specimens as covered by Test Methods E345.

7.4 *Test Method*—The tensile breaking load tests shall be made in accordance with Test Methods E345.

## 8. Covering Area

8.1 *Limits*—The covering area per pound shall be in accordance with the limits in Table 2.

8.2 *Number of Tests*—Specimens consisting of at least 16 in.<sup>2</sup> (103 cm<sup>2</sup>) of unspliced foil shall be taken to represent each 1000 lb (454 kg) or fraction thereof in a shipment. Not less than two specimens shall be taken when the shipment consists of more than one roll, or 50 sheets.

8.3 *Test Methods*—The covering area per pound shall be determined in accordance with Test Method E252. The covering area may also be determined by means of a direct-reading basis-weight scale, but in case of dispute, the covering area shall be determined by weighing to the nearest 1 mg a piece of unspliced foil not less than 10 ft (3 m) long and calculating the average area per pound by use of the following equation:

$$\text{Covering area, in.}^2/\text{lb} \quad (1)$$

$$= 453.6 \times \text{area of sample (in.}^2\text{)}/\text{weight of sample (g)}$$

NOTE 4—The covering area in Table 2 is based on a nominal density of 0.0975 lb/in.<sup>3</sup> (2.700 g/cm<sup>3</sup>) for a composition containing 99.35 % or greater aluminum. For a composition having less than 99.35 % aluminum, a nominal density of 0.098 lb/in.<sup>3</sup> (2.71 g/cm<sup>3</sup>) shall be used and the covering areas in Table 2 shall be adjusted accordingly.

**TABLE 2 Minimum, Maximum, and Nominal Covering Areas<sup>A</sup>**

Nominal Thickness		Nominal Covering Area		Permissible Range of Covering Area <sup>B</sup>			
				min		max	
in.	(mm)	in. <sup>2</sup> /lb (10 <sup>3</sup> )	(m <sup>2</sup> /kg)	in. <sup>2</sup> /lb (10 <sup>3</sup> )	(m <sup>2</sup> /kg)	in. <sup>2</sup> /lb (10 <sup>3</sup> )	(m <sup>2</sup> /kg)
0.00020	(0.0051)	51.3	(72.9)	46.6	(66.3)	57.0	(81.1)
0.00025	(0.0064)	41.0	(58.3)	37.3	(53.0)	45.6	(64.8)
0.00030	(0.0076)	34.2	(48.6)	31.1	(44.2)	38.0	(54.0)
0.00035	(0.0089)	29.3	(41.7)	26.6	(37.8)	32.6	(46.4)
0.00040	(0.0102)	25.6	(36.4)	23.3	(33.1)	28.5	(40.5)
0.00045	(0.0114)	22.8	(32.4)	20.7	(29.4)	25.3	(36.0)
0.00050	(0.0127)	20.5	(29.1)	18.6	(26.4)	22.8	(32.4)
0.00055	(0.0140)	18.6	(26.4)	17.0	(24.2)	20.7	(29.4)
0.00060	(0.0152)	17.1	(24.3)	15.5	(22.0)	19.0	(27.0)
0.00065	(0.0165)	15.8	(22.5)	14.3	(20.3)	17.5	(24.9)
0.00070	(0.0178)	14.6	(20.8)	13.3	(18.9)	16.3	(23.1)
0.00075	(0.0190)	13.7	(19.5)	12.4	(17.6)	15.2	(21.6)
0.00080	(0.0203)	12.8	(18.2)	11.7	(16.6)	14.2	(20.2)
0.00085	(0.0216)	12.1	(17.2)	11.0	(15.6)	13.4	(19.1)
0.00090	(0.0229)	11.4	(16.2)	10.4	(14.8)	12.7	(18.1)
0.00095	(0.0241)	10.8	(15.4)	9.81	(13.9)	12.0	(17.1)
0.0010	(0.0254)	10.3	(14.6)	9.32	(13.2)	11.4	(16.2)
0.0015	(0.0381)	6.83	(9.71)	6.22	(8.84)	7.60	(10.8)
0.0020	(0.0508)	5.13	(7.29)	4.66	(6.63)	5.70	(8.11)
0.0030	(0.0762)	3.42	(4.86)	3.11	(4.42)	3.80	(5.40)
0.0040	(0.1016)	2.56	(3.64)	2.33	(3.31)	2.85	(4.05)
0.005	(0.127)	2.05	(2.91)	1.86	(2.64)	2.28	(3.24)

<sup>A</sup> Covering area is based on a density of 0.0975 lb/cu in. for 1145 and 1235 aluminum. To obtain values for aluminum and aluminum alloys 1100, 8079, and 8111, divide by the density factor 1.005.

<sup>B</sup> Range of covering area based on the standard thickness tolerance of plus and minus 10 % per roll or shipment.