



Designation: B 479 – 00

Standard Specification for Annealed Aluminum and Aluminum-Alloy Foil for Flexible Barrier, Food Contact, and Other Applications¹

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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, 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 Section 1.1 preceded by A9, for example, A91100 for aluminum 1100 in accordance with Practice E 527.

¹ 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:

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications³

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum Base Alloys⁴

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition⁵

E 96 Test Methods for Water Vapor Transmission of Materials⁶

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁴

E 252 Test Method for Thickness of Thin Foil and Film by Weighing²

E 345 Test Methods of Tension Testing of Metallic Foil⁷

E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁵

E 716 Practices for Sampling of Aluminum and Aluminum Alloys for Spectrochemical Analysis⁵

E 1251 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge⁵

2.3 American National Standard:

² Annual Book of ASTM Standards, Vol 02.02.

³ Annual Book of ASTM Standards, Vol 14.02.

⁴ Annual Book of ASTM Standards, Vol 03.05.

⁵ Annual Book of ASTM Standards, Vol 03.06.

⁶ Annual Book of ASTM Standards, Vol 04.06.

⁷ Annual Book of ASTM Standards, Vol 03.01.

TABLE 1 Chemical Composition Limits^{A,B,C}

Si + Fe	1.8	Ti	0.08
Cu	0.20	Others—each ^D	0.05 ^{E,F}
Mn	0.10	Others—total ^D	0.15
Mg	0.05	Al, min.	98.00 ^G
Zn	0.10		

^A Limits are in percent maximum unless otherwise noted.

^B Analysis shall be made for the elements for which limits are shown in this table.

^C 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 E 29.

^D *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.

^E 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 E 29.

^F 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 Cr⁶⁺).

^G 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.

H35.1 Alloy and Temper Designation Systems for Wrought Aluminum⁸

Z1.4 Sampling Procedures and Tables for Inspection by Attributes⁸

3. Terminology

3.1 Definitions:

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 or lbs (kg),

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 (see 11.1),

4.2.3 Whether the intended use involves food processing, food packaging, or food preservation (see 6.1 and 15.2), and if so, what government regulations are applicable.

4.2.4 Whether certification is required (Section 13).

4.2.5 Whether Mullen test is required (see Section 11).

4.2.6 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.

NOTE 3—It is standard practice in the United States aluminum industry to determine conformance to the chemical composition limits prior to further processing of ingots or continuously cast plate or sheet into wrought products. Due to the continuous nature of the process, it is not practical to keep a specific ingot analysis identified with a specific quantity of finished material.

⁸ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

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 E 55.

6.3.2 Sampling for spectrochemical analysis shall be in accordance with Practices E 716. 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 E 34), or spectrochemical (Test Method E 227, E 607, and E 1251), 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*—The foil shall be capable of conforming to the tensile breaking loads in Table 2. Splices shall be capable of developing 80 % of the breaking load specified for unspliced foil.

NOTE 4—Tensile breaking loads define the strength properties good

TABLE 2 Tensile Breaking Load

Nominal Thickness		Breaking Load	
in.	(mm)	Pounds per Inch of Width, min	(Kilograms per centimetre of Width, min)
0.00025	(0.0064)	1.6	(0.29)
0.00030	(0.0076)	1.9	(0.34)
0.00035	(0.0089)	2.2	(0.39)
0.00040	(0.0102)	2.6	(0.46)
0.00045	(0.0114)	2.9	(0.52)
0.00050	(0.0127)	3.2	(0.57)
0.00055	(0.0140)	3.5	(0.63)
0.00060	(0.0152)	3.8	(0.68)
0.00065	(0.0165)	4.1	(0.73)
0.00070	(0.0178)	4.4	(0.79)
0.00080	(0.0203)	5.2	(0.93)
0.00090	(0.0229)	5.7	(1.02)
0.001	(0.0254)	6.4	(1.14)
0.0015	(0.0381)	9.6	(1.71)
0.002	(0.0508)	12.8	(2.28)
0.003	(0.0762)	19.2	(3.42)
0.004	(0.1016)	25.6	(4.56)
0.005	(0.127)	32.0	(5.7)

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 E 345.

7.4 *Test Method*—The tensile breaking load tests shall be made in accordance with Test Methods E 345.

8. Covering Area

8.1 *Limits*—The covering area per pound shall be in accordance with the limits in Table 3.

8.2 *Number of Tests*—Specimens consisting of at least 16 in.² (103 cm²) 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 E 252. 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:

$$\begin{aligned} \text{Covering area, in.}^2/\text{lb} & \quad (1) \\ & = 453.6 \times \text{area of sample (in.}^2\text{)}/\text{weight of sample (g)} \end{aligned}$$

NOTE 5—The covering area in Table 3 is based on a nominal density of 0.0975 lb/in.³ (2.700 g/cm³) 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.³ (2.71 g/cm³) shall be used and the covering areas in Table 3 shall be adjusted accordingly.

9. Dimensional Tolerances

9.1 *Rolls*—Rolls shall be wound on metal cores having an inside diameter of 1 $\frac{1}{16}$ ± 0.012 in. (33.3 ± 0.3 mm), 3 ± 0.015 in. (76.2 ± 0.4 mm) or 6 ± 0.030 in. (152.4 ± 0.8 mm), as specified by the purchaser. For specified foil widths up through 12 in. (305 mm) the dimensional tolerance shall be ± $\frac{1}{64}$ in. (0.4 mm), and for widths over 12 in. it shall be ± $\frac{1}{32}$ in. (0.8 mm). The maximum outside roll diameter shall be as specified by the purchaser.

9.2 *Flat Sheets*—The nominal width (perpendicular to rolling direction) and length (parallel to rolling direction) of flat sheets shall be as specified by the purchaser and the permissible deviations from specified width and length shall be ± $\frac{1}{16}$ in. (1.6 mm).

10. General Quality

10.1 The foil shall be free from splits, slivers, wrinkles, ragged edges, and excessive pinholes.

NOTE 6—Foil in thickness about 0.002 in. (0.05 mm) and heavier is virtually free of pinholes. With decrease in thickness, the number of pinholes and variability in their number increases. Present test methods for determining pinholes do not permit the establishment of quantitative limits in thin foil.