Designation: B 317 – 002

Standard Specification for Aluminum-Alloy Extruded Bar, Rod, Tube, Pipe, and Structural Profiles for Electrical Purposes (Bus Conductor)[1]

This standard is issued under the fixed designation B 317; 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.

This standard has been approved for use by agencies of the Department of Defense.

[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.

Current edition approved ~~May~~ Oct. 10, 200~~0~~2. Published ~~August 2000.~~ January 2003. Originally ~~published as B 317–57 T.~~ approved in 1957. Last previous edition approved in 2000 as B 317–~~96~~00.

1. Scope *

1.1 This specification covers 6101 aluminum-alloy extruded bar, rod, tube, pipe (Schedules 40 and 80), and structural profiles (channels and angles) in selected tempers for use as electric conductors as follows:

1.1.1 *Type B*—Hot-finished bar, rod, tube, pipe and structural profiles in T6, T61, T63, T64, T65, and H111 tempers with Type B tolerances, as shown in the "List of ANSI Tables of Dimensional Tolerances."

1.1.2 *Type C*—Hot-finished rectangular bar in T6, T61, T63, T64, T65, and H111 tempers with Type C tolerances as listed in the tolerances and permissible variations tables.

1.2 Alloy and temper designations are in accordance with ANSI H35.1. The equivalent Unified Numbering System alloy designation in accordance with Practice E 527 is A96101 for Alloy 6101.

NOTE 1—Type A material, last covered in the 1966 issue of this specification, is no longer available; therefore, requirements for cold-finished rectangular bar have been deleted.

1.3 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see Annex A2.

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

2. Referenced Documents

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

2.2 *ASTM Standards:*

B 193 Test Method for Resistivity of Electrical Conductor Materials[2]

B 253 Guide for Preparation of Aluminum Alloys for Electroplating[3]

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products[4]

~~B 597 Practice for Heat Treatment of Aluminum Alloys~~[4]

~~B 660 Practices~~ 660 Practices for Packaging/Packing of Aluminum and Magnesium Products[4]

B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products[4]

B 807 Practice for Extrusion Press Solution Heat Treatment of Aluminum Alloys[4]

B 918 Practice for Heat Treatment of Wrought Aluminum Alloys[4]

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[5]

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum Base Alloys[6]

E 55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition[6]

E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique[6]

[2] *Annual Book of ASTM Standards*, Vol 02.03.
[3] *Annual Book of ASTM Standards*, Vol 02.05.
[4] *Annual Book of ASTM Standards*, Vol 02.02.
[5] *Annual Book of ASTM Standards*, Vol 14.02.
[6] *Annual Book of ASTM Standards*, Vol 03.05.

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

E 290 Test Methods for ~~Semi-Guided~~ Bend Testing of Material for Ductility ~~of Metallic Materials~~[7]
E 527 Practice for Numbering Metals and Alloys (UNS)[8]
E 607 Test Method for ~~Optical~~ Atomic Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere[6]
E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis[6]
E ~~1004 Test Method~~ 1004 Practice for ~~Electromagnetic (Eddy-Current) Measurements of~~ Determining Electrical Conductivity Using the Electromagnetic (Eddy-Current) Method[9]
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 Discharge[6]
2.3 *ANSI Standards:*[4]
H35.1 Alloy and Temper Designation Systems for Aluminum
H35.2 Dimensional Tolerances for Aluminum Mill Products
2.4 *Military Standard:*[10]
MIL-STD-129 Marking for Shipment and Storage
2.5 *Federal Standard:*[10]
Fed. Std. No. 123 Marking for Shipment (Civil Agencies)

3. Terminology

3.1 *Definitions:*
3.1.1 *bus conductor*—a rigid electric conductor of any cross section.
3.1.2 *extruded bar*—an extruded solid section long in relation to its cross-sectional dimensions, having a symmetrical cross section that is square or rectangular (excluding flattened wire) with sharp or rounded corners or edges, or is a regular hexagon or octagon, and whose width or greatest distance between parallel faces is ⅜ in. (9.5 mm) or greater.
3.1.3 *extruded rod*—an extruded solid round section ⅜ in. (9.5 mm) or greater in diameter, whose length is great in relation to its diameter.
3.1.4 *extruded tube*—an extruded hollow wrought product that is long in relation to its cross section, that is round, a regular hexagon, a regular octagon, elliptical, square, or rectangular with sharp or round corners, and that has uniform wall thickness except as affected by corner radii.
3.1.5 *extruded pipe*—extruded tube in standardized combinations of outside diameter and wall thickness, commonly designated by "Nominal Pipe Sizes" and "ANSI Schedule Numbers."
3.1.6 *extruded structural profile*—an extruded profile, commonly used for structural purposes but limited to profiles producible by rolling, such as angles and channels.

NOTE 2—Tees, zees, I-beams, and H-sections are rarely used as conductors.

3.1.7 *producer*—the primary manufacturer of the material.
3.1.8 *supplier*—includes only the category of jobbers and distributors as distinct from producers.
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 pounds or pieces,
4.1.3 Type (1.1.1 and 1.1.2),
4.1.4 Temper (Section 9, Table 2),
4.1.5 Type of section (Section 3),
4.1.6 *Cross-Sectional Dimensions: Bar*— Thickness and width, or distance across flats, and edge contour (Section 13); *Rod*—Diameter; *Pipe*—Nominal pipe size and schedule number (40 or 80); *Structural Profile*—Nominal dimensions and type of section; *Round Tube*—Outside or inside diameter and wall thickness; *Square or Sharp-Cornered Tube*—Distance across flats and wall thickness; *Round-Cornered Tube Other than Round*—A drawing is required,
4.1.7 Length,

[7] *Annual Book of ASTM Standards*, Vol 03.01.
[8] *Annual Book of ASTM Standards*, Vol 01.01.
[9] *Annual Book of ASTM Standards*, Vol 03.063.
~~*Annual Book of ASTM Standards*, Vol 03.03.~~
[10] Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094 Attn: NPODS.

TABLE 1 Chemical Composition Limits[A,B,C]

Element	Alloy Designation 6101 Composition, %
Silicon	0.30–0.7
Iron	0.50
Copper	0.10
Manganese	0.03
Magnesium	0.35–0.8
Chromium	0.03
Zinc	0.10
Boron	0.06
Other elements:[D]	
Each	0.03
Total[E]	0.10
Aluminum	remainder

[A] Limits are in weight percent maximum unless shown as a range.
[B] Analysis shall be made for the elements for which limits are shown in this table.
[C] To determine conformance to these limits, an observed value or a calculated value obtained from analysis shall be rounded off to the nearest unit in the last right-hand place of the figures used in expressing the specified limit, in accordance with the rounding-off 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 nonconforming.
[E] *Other Elements*—Total shall be the sum of unspecified metallic elements 0.010 % or more, rounded to the second decimal before determining the sum.

TABLE 2 Tensile Property Limits[A,B,C]

Temper	Specified Thickness, in.	Tensile Strength, ksi (MPa)		Yield Strength, (0.2 % offset), ksi (MPa)	
		min	max	min	max
T6	0.125–0.500	29.0 (200)	...	25.0 (172)	...
T61	0.125–0.749	20.0 (138)	...	15.0 (103)	...
	0.750–1.499	18.0 (124)	...	11.0 (76)	...
	1.500–2.000	15.0 (103)	...	8.0 (55)	...
T63[D]	0.125–0.500	27.0 (186)	...	22.0 (152)	...
T64	0.125–1.000	15.0 (103)	...	8.0 (55)	...
T65	0.125–0.749	25.0 (172)	32.0 (221)	20.0 (138)	27.0 (186)
H111	0.250–2.000	12.0 (83)	...	8.0 (55)	...

[A] To determine conformance to this specification, each value shall be rounded off to the nearest 0.1 ksi (1 MPa) for strength in accordance with the rounding-off method of Practice E 29.
[B] For explanation of SI unit MPa, see Appendix X2.
[C] See Annex A1.
[D] Formerly designated T62 temper.

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

4.2.1 Whether solution heat treatment at the extrusion press is unacceptable (8.2),

4.2.2 Whether witness of inspection by the purchaser's representative is required prior to material shipment (Section 16),

4.2.3 Whether marking for identification is required (Section 18),

4.2.4 Whether certification is required (Section 20), and

4.2.5 Whether Practices B 660 applies and, if so, the levels of preservation, packaging, packing and marking required (Section 19).

5. Manufacture

5.1 The bars, rods, tubes, pipe, or structural profiles shall be produced by hot extrusion or by similar methods at the option of the producer, provided that the production method results in material that meets all requirements of this specification.

6. Quality Assurance

6.1 *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. 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 in the order or at the time of contract signing. 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 material conforms to prescribed requirements.

6.2 *Lot Definition*—An inspection lot shall be defined as follows:

6.2.1 For heat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and thickness traceable to a heat-treat lot or lots, and subjected to inspection at one time.

6.2.2 For nonheat-treated tempers, an inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and thickness subjected to inspection at one time.

7. Chemical Composition

7.1 *Limits*—The material shall conform to the chemical composition limits in Table 1. Conformance shall be determined by the producer by analyzing samples taken at the time ingots are poured, or samples taken from the finished or semifinished product. If chemical composition has been determined during the course of manufacture, analysis of the finished product shall not be required.

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 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.

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

7.2.1 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.

7.2.2 When samples are taken from the finished or semifinished product, a sample shall be taken to represent each 4000 lb (1800 kg), or fraction thereof, in the lot, except that not more than one sample shall be required per piece.

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

7.3.1 Samples for chemical analysis shall be taken from the material by sawing, milling, turning, or 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.

7.3.2 Sampling for spectrochemical analysis shall be in accordance with Practices E 716. Samples for other methods of analysis shall be taken by methods suitable for the form of material being analyzed and the type of analytical method used.

7.4 *Methods of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E 34) or spectrochemical (Test Methods 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 upon between the producer and purchaser.

8. Heat Treatment

8.1 Except as noted in 8.2, heat treatment shall be in accordance with Practice ~~B 597.~~ B 918.

8.2 Unless otherwise specified, Alloy 6101 may be solution heat-treated and quenched at the extrusion press in accordance with Practice B 807 in the production of T6-type tempers.

9. Tensile Properties of Material as Supplied

9.1 *Limits*—The material shall conform to the tensile properties in Table 2.

9.2 *Number of Specimens*—One tension test specimen shall be taken from a random piece representing each 3000 lb (1350 kg) of material, or fraction thereof, of the same temper, thickness, and width or cross section in the shipment. If a shipment contains material of more than one size, only that material of the same cross section shall be grouped for the purpose of selecting tension test specimens. Other procedures for selecting samples may be employed if agreed between the producer and purchaser.

9.3 *Test Methods*—The tension tests shall be made in accordance with Test Methods B 557.

10. Bend Properties

10.1 *Limits*:

10.1.1 *Flatwise Bends*—Bars shall be capable of being bent at room temperature through an angle of 90° around a pin or mandrel having a radius equal to *N* times its thickness without developing cracks or ruptures visible to the unaided eye corrected for normal vision. Surface roughening (“orange peel” appearance) is not considered to be an injurious defect. The value of *N* is specified in Table 3 for specific tempers and thicknesses.

10.1.2 *Edgewise Bends*—Bars in the T64 and H111 tempers having a maximum thickness of ¼ in. (6.4 mm) and a maximum width of 2 in. (50.8 mm) shall be capable of being bent edgewise at room temperature through an angle of 90° to an inside bend radius equal to one half the bar width without developing cracks or ruptures visible to the unaided eye corrected for normal vision. An edgewise bend shall be considered satisfactory if the thickness within the vicinity of any localized thinning is not less than 90 % of the maximum thickness within the center 60° of the bend when measured only along the outer edge of the bend.

10.2 *Number of Specimens*—The number of specimens (test frequency) shall be the same as for tension tests as required in 9.2.

10.3 *Test Specimens*—Bend test specimens (bar only) shall be a full section of the material with a minimum length of 12 in. (305 mm).

10.4 *Test Methods*—Bend tests shall be made in accordance with Test Method E 290.

TABLE 3 Flatwise Bend Radii

Temper	Specified Thickness, in.	Bend Factor, N^A
T6	0.125–0.375	2
	0.376–0.500	2½
T61	0.125–0.500	1
	0.501–0.749	2
	0.750–1.000	3
	1.001–1.625	4
T63[B]	0.125–0.375	1
	0.376–0.500	1½
T64	0.125–0.750	1
	0.751–1.000	2
T65	0.125–0.500	1
	0.501–0.749	2
H111	0.250–0.750	1
	0.751–1.000	2

[A] Applicable to widths up through 6 in. (152 mm) in the T6, T61, T63, and T65 tempers and to widths up through 12 in. (305 mm) for all other listed tempers.
[B] Formerly designated T62 temper.

11. Density

11.1 The density of 6101 alloy shall be taken as 0.0975 lb/in.^{3}(2700 kg/m^3).

12. Electrical Properties

12.1 *Limits*—The material shall conform to the maximum resistivity requirements specified in Table 4.

12.2 *Number of Specimens*—The number of specimens (test frequency) shall be the same as for tension tests as required in 9.2.

12.3 *Test Specimens*—The specimens shall, when practical, be a full section of the material but may be of suitable size and shape for the test instrument.

12.4 *Test Methods*—Resistivity or conductivity shall be determined in accordance with Test Methods B 193 or Practice E 1004, provided that in case of dispute, the results obtained by Test Method B 193 shall be the basis for acceptance.

13. Edge Contours

13.1 Unless specified otherwise, bar shall be furnished with square corners. When specified, bar shall be furnished with rounded corners, rounded edges or full rounded edges, as shown in Table 19.3.4 of ANSI H35.2.

14. Dimensional Tolerances

14.1 Rectangular bar ordered to Type C dimensional tolerances shall conform to the thickness tolerances in Table 5, width tolerances in Table 6, and flatness tolerances in Table 7. In addition, the bar shall conform to the requirements for straightness, corner or edge radii, twist, length, squareness of cut ends, or angularity prescribed in the tables of ANSI H35.2 (see Table 8).

14.1.1 Rectangular bar and rod ordered to Type B dimensional tolerances shall conform to the applicable tables of ANSI H35.2 (see Table 8).

14.2 Tube, pipe, and structural profiles shall conform to the permissible variations prescribed in the applicable tables of ANSI H35.2 (see Table 8).

14.3 *Number of Samples*—Examination for dimensional conformance shall be made to ensure conformance to the tolerance specified.

15. General Quality

15.1 Unless otherwise specified, the material shall be supplied in the mill finish and shall be uniform as defined by the

TABLE 4 Resistivity and Conductivity Limits

Temper	Weight Resistivity at 20°C, max, Ω·g/m^2	Volume Conductivity at 20°C, min, percent of IACS[A]
T6	0.0846	55.0
T61	0.0817	57.0
T63	0.0831	56.0
T64	0.0782	59.5
T65	0.0824	56.5
H111	0.0789	59.0

[A] International Annealed Copper Standard.

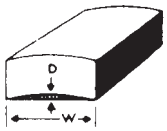
TABLE 5 Type C Thickness Tolerance for Rectangular Bar

Specified Thickness, in.	Tolerance, Plus and Minus, in.
0.125–0.500	0.005

TABLE 6 Type C Width Tolerances for Rectangular Bar

Specified Width, in.	Minimum Thickness, in.	Tolerance, Plus and Minus, in.
Up through 0.875	0.125	0.005
0.876–1.000	0.125	0.006
1.001–1.500	0.125	0.008
1.501–2.000	0.125	0.012
2.001–3.000	0.250	0.012
3.001–5.000	0.250	0.017
5.001–6.000	0.250	0.022
6.001–8.000	0.250	0.030

TABLE 7 Type C Rectangular Bar, All Tempers, Cold Flattened, Permissible Variations in Flatness

Surface Width, in.	Tolerance,[A] in.
	 Maximum Allowable Deviation D
Over 4 through 8	0.002 × *W* (in.)
In any 1 in. of width	0.003

[A] Flatness deviations shall be measured using a standard feeler gage.

TABLE 8 List of ANSI Tables[A] of Dimensional Tolerances

Dimension	Table No.			Tube
	Rod and Bar	Pipe	Structural Profiles	
Thickness	19.3.1[B]	19.5.2	...	12.3,12.4
Width	19.3.1[B]	...	...	12.2
Diameter	19.3.1	19.5.1	...	12.1
Edge contour	19.3.4	...	...	...
Cross section	...	...	19.4.1	...
Weight	...	19.5.5	...	...
Length	19.3.2	19.5.4	19.4.2	12.5
Flatness	19.3.3[B]	...	19.4.6	12.8
Twist	19.3.5	...	19.4.3	12.6
Angularity	19.3.7	...	19.4.4	12.11
Straightness	19.3.6	19.5.3	19.4.5	12.7
Squareness of cut ends	19.3.8	...	19.4.7	12.9

[A] ANSI H35.2.
[B] Apply for Type B bar only. See Tables 5, 6, and 7 for Type C bar.

requirements of this specification and shall be commercially sound. Any requirement not so covered is subject to negotiation between producer and purchaser.

15.2 The material shall be capable of being satisfactorily electroplated in accordance with the provisions of Guide B 253.

15.3 Each bar, rod, tube, pipe, and structural profile shall be examined to determine conformance to this specification with respect to general quality and identification marking. On approval of the purchaser, the producer may use a system of statistical quality control for such examinations.

16. Source Inspection

16.1 If the purchaser desires that his representative inspect or witness the inspection and testing of the material prior to shipment, such agreement shall be made by the purchaser and producer as part of the purchase contract.

16.2 When such inspection or witness of inspection and testing is agreed upon, the producer shall afford the purchaser's representative all reasonable facilities to satisfy him that the material meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

17. Rejection and Retest

17.1 If any material fails to conform to all of the applicable requirements of this specification, it shall be cause for rejection of the inspection lot.

17.2 When there is evidence that a failed specimen was not representative of the inspection lot and when no other sampling plan is provided or approved by the purchaser through the contract or purchase order, at least two additional specimens shall be selected to replace each test specimen that failed. All specimens so selected for retest shall meet the requirements of the specification or the lot shall be subject to rejection.

17.3 Material in which defects are discovered subsequent to inspection may be rejected.

17.4 If material is rejected by the purchaser, the producer or supplier is responsible only for replacement of the material to the purchaser. As much as possible of the rejected material shall be returned to the producer or supplier.

18. Identification Marking of Product

18.1 When specified on the purchase order or contract, all bar, rod, tube, pipe, and structural profiles shall be marked in accordance with Practice B 666.

18.2 Marking systems that involve added information, larger characters, and greater frequencies are acceptable under this specification when agreed upon between the producer and purchaser.

19. Packaging and Package Marking

19.1 The material shall be packaged to provide adequate protection during normal handling and transportation and each package shall contain only one size or shape and temper of material unless otherwise agreed. The type of packing and gross weight of containers shall, unless otherwise agreed, be at the producer or supplier's discretion, provided they are such as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.

19.2 Each shipping container shall be marked with the purchase order number, material size, specification number, alloy and temper, gross and net weights, and the producer or supplier's name or trademark.

19.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B 660. The applicable levels shall be as specified in the contract or order. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

20. Certification

20.1 The producer or supplier shall, upon request, furnish to the purchaser a certificate stating that the material has been sampled, tested and inspected in accordance with this specification, and has met the requirements.

21. Keywords

21.1 aluminum alloy; bus conductor; extrusions

ANNEXES

(Mandatory Information)

A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

A1.1 Limits are established at a level at which a statistical evaluation of the data indicates that 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits for the respective size ranges are based on the analyses of at least 100 data from standard production material with no more than ten data from a given lot. All tests are performed in accordance with the appropriate ASTM test methods. For informational purposes, refer to "Statistical Aspects of Mechanical Property Assurance" in the Related Material section of the *Annual Book of ASTM Standards*, Vol 02.02.

A2. ACCEPTANCE CRITERIA FOR INCLUSION OF NEW ALUMINUM AND ALUMINUM ALLOYS IN THIS SPECIFICATION

A2.1 Prior to acceptance for inclusion in this specification, the composition of wrought or cast aluminum or aluminum alloy shall be registered in accordance with ANSI H35.1. The Aluminum Association[11] holds the Secretariat of ANSI H35 Committee and administers the criteria and procedures for registration.

A2.2 If it is documented that the Aluminum Association could not or would not register a given composition, an alternative procedure and the criteria for acceptance shall be as follows:

A2.2.1 The designation submitted for inclusion does not utilize the same designation system as described in ANSI H35.1. A designation not in conflict with other designation systems or a trade name is acceptable.

A2.2.2 The aluminum or aluminum alloy has been offered for sale in commercial quantities within the prior twelve months to at least three identifiable users.

A2.2.3 The complete chemical composition limits are submitted.

A2.2.4 The composition is, in the judgment of the responsible subcommittee, significantly different from that of any other aluminum or aluminum alloy already in the specification.

A2.2.5 For codification purposes, an alloying element is any element intentionally added for any purpose other than grain refinement and for which minimum and maximum limits are specified. Unalloyed aluminum contains a minimum of 99.00 % aluminum.

A2.2.6 Standard limits for alloying elements and impurities are expressed to the following decimal places:

Less than 0.001 %	0.000X
0.001 to but less than 0.01 %	0.00X
0.01 to but less than 0.10 %	
Unalloyed aluminum made by a refining process	0.0XX
Alloys and unalloyed aluminum not made by a refining process	0.0X
0.10 through 0.55 %	0.XX
(It is customary to express limits of 0.30 through 0.55 % as 0.X0 or 0.X5.)	
Over 0.55 %	0.X, X.X, etc.
(except that combined Si + Fe limits for 99.00 % minimum aluminum must be expressed as 0.XX or 1.XX)	

A2.2.7 Standard limits for alloying elements and impurities are expressed in the following sequence: Silicon; Iron; Copper; Manganese; Magnesium; Chromium; Nickel; Zinc (Note A2.1); Titanium; Other Elements, Each; Other Elements, Total; Aluminum (Note A2.2).

NOTE A2.1—Additional specified elements having limits are inserted in alphabetical order of their chemical symbols between zinc and titanium, or are specified in footnotes.

NOTE A2.2—Aluminum is specified as *minimum* for unalloyed aluminum and as a *remainder* for aluminum alloys.

[11] ~~Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094 Attn: NPODS.~~
[11] The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.

APPENDIXES

(Nonmandatory Information)

X1. EQUIVALENT RESISTIVITY VALUES

X1.1 Equivalent resistivity values are given in Table X1.1.

TABLE X1.1 Equivalent Resistivity Values[A]

Material	Volume Conductivity, at 20°C (68°F) % IACS[B]	Resistivity at 20°C (68°F)				
		Weight		Volume		
		μΩ·lb/ft²	Ω·g/m²	Ω·mm²/m	μΩ·in.	μΩ·cm
Copper	100	31.393	0.15328	0.017241	0.67879	1.7241
Aluminum Alloy 6101	55.0	17.336	0.084639	0.031348	1.2342	3.1348
	56.0	17.026	0.083128	0.030788	1.2121	3.0788
	56.5	16.875	0.082392	0.030516	1.2014	3.0516
	57.0	16.727	0.081670	0.030248	1.1909	3.0248
	59.0	16.160	0.078901	0.029223	1.1505	2.9223
	59.5	16.025	0.078238	0.028977	1.1408	2.8977

[A] Based on a density of 2700 kg/m³ for Aluminum Alloy 6101.
[B] International Annealed Copper Standard.

X2. METRIC EQUIVALENTS

X2.1 The SI unit for strength properties now shown is in accordance with the International System of Units (SI). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ($N = kgf \cdot m/s^2$). The derived SI unit for pressure or stress is the newton per square metre (N/m^2), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since 1 ksi = 6 894 757 Pa the metric equivalents are expressed as megapascal (MPa), which is the same as MN/m^3 and N/mm^2.

SUMMARY OF CHANGES

This section identifies the principal changes to this standard that have been incorporated since the last issue.
(1) Deleted references to Test Method E 101.