



Standard Specification for Aluminum-Alloy Rolled Tread Plate¹

This standard is issued under the fixed designation B 632/B 632M; 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. Scope *

1.1 This specification covers aluminum-alloy rolled flat tread plate, mill-finish, with a raised pattern on one side, in the alloy, tempers, and thicknesses shown in Table 1 and Table 2 [Table 3].

1.2 Alloy and temper designation are in accordance with ANSI H35.1 [H35.1M]. The equivalent Unified Numbering System alloy designation are those of Table 1 preceded by A9, which is A96061 for alloy 6061 and A93003 for Alloy 3003 in accordance with Practice E 527.

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 either inch-pound or SI units are to be regarded separately as standard. The SI units are shown either in brackets or in separate tables. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems will result in nonconformance with the specification.

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 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products²
- B 557M Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products [Metric]²
- B 597 Practice for Heat Treatment of Aluminum Alloys²
- B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products²
- B 666/B 666M Practice for Identification Marking of Aluminum and Magnesium Products²
- B 881 Standard Terminology Relating to Aluminum and Aluminum Alloy 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 Composition⁴
- E 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁴
- E 290 Test Method for Semi-Guided Bend Test for Ductility of Metallic Materials⁵
- E 527 Practice for Numbering Metals and Alloys (UNS)⁶
- E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁷
- E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁷
- 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 Discharge⁷

2.3 ANSI Standards:

- H35.1 Alloy and Temper Designation Systems for Aluminum²
- H35.1M Alloy and Temper Designation Systems for Aluminum [Metric]
- H35.2 Dimensional Tolerances for Aluminum Mill Products²
- H35.2M Dimensional Tolerances for Aluminum Mill Products [Metric]²

3. Terminology

3.1 *Definitions:* Refer to Terminology B 881 for definitions of product terms used in this specification.

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 tests need not be performed. However, should testing by the purchaser establish that the material does not meet these requirements, the material shall be subject to rejection.

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 *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 03.01.

⁶ *Annual Book of ASTM Standards*, Vol 01.01.

⁷ *Annual Book of ASTM Standards*, Vol 03.06.

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

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

Alloy	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements ^D		Aluminum
									Each	Total ^E	
3003	0.6	0.7	0.05-0.20	1.0-1.5	---	---	0.10	---	0.05	0.15	Remainder
6061	0.40-0.8	0.7	0.15-0.40	0.15	0.8-1.2	0.04-0.35	0.25	0.15	0.05	0.15	Remainder

^ALimits in weight percent maximum unless shown as a range or minimum

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

^CFor 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 of figures used in expressing the specified limit, in accordance with the rounding off method of Practice E 29.

^DOthers includes listed elements for which no specific limit is shown as well as 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 purchaser establish that an Others element exceed 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 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 Properties, Inch-Pound Units^{A,B}

Alloy and Temper	Specified Thickness ^C , in.	Tensile Strength, ksi		Yield Strength (0.2 % Offset), ksi		Elongation in 2 in. or 4 ^D , min, %
		min	max	min	max	
	0.114-0.161	19.0	...	15.0	...	6
	0.162-0.188	19.0	...	15.0	...	7
6061-O	0.100-0.128	...	22.0	...	12.0	16
	0.129-0.499	...	22.0	...	12.0	18
	0.500-0.625	...	22.0	...	...	18
6061-T4	0.100-0.249	30.0	...	16.0	...	14
	0.250-0.625	30.0	...	16.0	...	16
6061-T42 ^E	0.100-0.249	30.0	...	14.0	...	14
	0.250-0.625	30.0	...	14.0	...	16
6061-T6 and T62 ^E	0.100-0.188	42.0	...	35.0	...	6
	0.189-0.249	42.0	...	35.0	...	8
	0.250-0.499	42.0	...	35.0	...	10
	0.500-0.625	42.0	...	35.0	...	9
6061-F	0.100-0.625	no requirements				

^A To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 0.1 ksi and each value for elongation to the nearest 0.5 %, both in accordance with the rounding-off method of Practice E 29.

^B See Annex A1 for the basis for establishment of mechanical property limits.

^C For sheet and plate under 1/2 in. in thickness, the standard 1/2 in. wide tension test specimen shall be used. Unless otherwise specified, rectangular tension test specimens may be tested without the removal of the raised pattern.

^D The specimen diameter is represented by *D*.

^E This temper is not available from the material producer.

4. Ordering Information

4.1 Orders for material under 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),

NOTE 1—For inch-pound orders, specify Specification B 632; for metric orders, specify B 632M. Do not mix units.

4.1.2 Quantity in pieces or pounds [kilograms],

4.1.3 Alloy (7.1),

4.1.4 Temper (9.1),

4.1.5 Dimensions (thickness, width, and length),

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

4.2.1 Whether tension test specimens that retain the pattern are unacceptable (Table 2, footnote C).

4.2.2 Whether bend tests are required (10.1),

4.2.3 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (13.1),

4.2.4 Whether certification of the material by the producer or supplier is required (17.1),

4.2.5 Whether marking is required (15.1), and

4.2.6 Whether Practice B 660 applies and, if so, the levels of preservation, packaging, and packing required (16.3).

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. 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.

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

5.2.1 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.

5.2.2 For nonheat-treated tempers, an inspection lot shall

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TABLE 3 Tensile Properties [SI Units]^{A,B}

Alloy and Temper	Specified Thickness, ^C mm		Tensile Strength, MPa		Yield Strength (0.2 % Offset), MPa		Elongation, min, %	
	Over	Through	min	max	min	max	in 50 mm	5D ^D
3003-H231	2.50	3.20	130	...	105	...	5	...
	3.20	4.00	130	...	105	...	6	...
	4.00	5.00	130	...	105	...	7	...
6061-O	2.49	3.20	...	150	...	85	16	...
	3.20	12.50	...	150	...	85	18	...
	12.50	16.00	...	150	...	...	...	16
6061-T4	2.49	6.30	205	...	110	...	14	...
	6.30	12.50	205	...	110	...	16	...
	12.50	16.00	205	...	110	...	...	14
6061-T42 ^E	2.49	6.30	205	...	95	...	14	...
	6.30	12.50	205	...	95	...	16	...
	12.50	16.00	205	...	95	...	...	14
6061-T6 and T62 ^E	2.49	5.00	290	...	240	...	6	...
	5.00	6.30	290	...	240	...	8	...
	6.30	12.50	290	...	240	...	10	...
	12.50	16.00	290	...	240	...	...	8
6061-F	2.49	16.00	no requirements					

^A To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded to the nearest 1 MPa and each value for elongation to the nearest 0.5 %, both in accordance with the rounding-off method of Practice E 29.

^B See Annex A1 for the basis for establishment of mechanical property limits.

^C For sheet and plate through 12.50 mm in thickness, the standard 12.50-mm wide tension test specimen shall be used. The raised figures of the pattern should be machined off before testing. Unless otherwise specified, rectangular tension specimens may be tested without the removal of the raised pattern.

^D The specimen diameter is represented by *D*.

^E This temper is not available from the material producer.

consist of an identifiable quantity of material of the same mill form, alloy, temper, and thickness subjected to inspection at one time.

6. General Quality

6.1 Unless otherwise specified, all tread plate shall be supplied in the mill finish and shall be uniform as defined by the requirements of this specification and shall be commercially sound. Any requirement not so covered is subject to negotiation between the producer and the purchaser.

6.2 Each piece shall be examined to determine conformance to this specification with respect to general quality and identification marking. On approval of the purchaser, however, a system of statistical quality control may be used for such examinations.

7. Chemical Composition

7.1 *Limits*—The tread plate shall conform to the chemical composition limits specified in Table 1. Conformance shall be determined by analyzing samples taken at the time the ingots are cast, or samples taken from the finished or semifinished product. If the chemical composition of the material has been determined during the course of manufacture, additional sampling and analysis of the finished product shall not be necessary.

NOTE 2—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 the determination of chemical composition shall be as follows:

7.2.1 When samples are taken at the time the ingots are cast, at least one sample shall be taken for each group of ingots cast

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 [2000 kg] or fraction thereof, of material 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 by drilling, 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 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 method of analysis shall be agreed upon between the producer and purchaser.

8. Heat Treatment

8.1 Producer or supplier heat treatment for the applicable tempers of alloy 6061 in Table 2 [Table 3] shall be in accordance with Practice B 597.

9. Tensile Properties of Materials as Supplied

9.1 *Limits*—The tread plate shall conform to the tensile properties specified in Table 2 [Table 3].

9.2 *Number of Specimens*—One specimen shall be taken from a randomly selected piece representing the following

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quantities of tread plate in a lot:

Thickness, in. [mm]	Quantity
0.100–0.249 [over 2.49 through 6.30]	2000 lb or less [1000 kg]
0.250–0.625 [over 6.30 through 16.00]	4000 lb or less [2000 kg]

Other procedures for selecting samples may be employed if approved by the purchaser.

9.3 *Test Specimens*—Geometry of test specimens and the location in the product from which they are taken shall be as specified in Test Methods B 557 [B 557M].

9.4 *Test Methods*—The tension test shall be made in accordance with Test Methods B 557 [B 557M].

10. Bend Properties

10.1 *Limits*—Tread plate shall be capable of being bent cold through an angle of 180° around a pin having a diameter equal to *N* times the thickness of the sheet or plate without cracking, the value of *N* being as prescribed in Table 4 for the specified tempers and thicknesses. The test need not be conducted unless specified on the purchaser order.

10.2 *Number of Specimens*—The number of specimens from each lot of material to be tested shall be as specified in 9.2.

10.3 *Test Specimens*—When bend tests are made, the specimens shall be the full thickness of the material, approximately ¾ in. [20 mm] in width, and when practical, at least 6 in. [150 mm] in length. Such specimens may be taken in any direction and their edges may be rounded to a radius of approximately 1/16 in. [2 mm] if desired. The pattern side of the product shall be on the outside of the bend.

10.4 *Test Methods*—The bend tests shall be made in accordance with Test Method E 290 except as stated otherwise in 10.3.

11. Producer Confirmation of Heat-Treat Response for 6061

11.1 In addition to the requirements of 9.1 and 10.1, mill-produced 6061 material in the O or F temper (without the subsequent imposition of cold work or forming operations) shall be capable, upon proper solution heat treatment and natural aging at room temperature, of developing the properties specified in Table 2 [Table 3] and Table 4 for T42 temper material. The natural aging period at room temperature shall be

not less than 4 days, but samples of material may be tested prior to 4 days aging, and if the material fails to conform to the requirements of T42 temper material, the tests may be repeated without prejudice after completion of 4 days aging.

11.2 Alloy 6061 material in the T4 and T42 tempers shall, after proper precipitation heat treatment, be capable of attaining the properties specified in Table 2 [Table 3] and Table 4 for the T6 and T62 tempers respectively.

11.3 *Number of Specimens*—The number of specimens from each lot of O temper material and F temper material to be tested to verify conformance with 11.1 and 11.2 shall be as specified in 9.2.

12. Tolerances

12.1 *Weight [Mass]*—The allowable deviation from nominal weight as shown in Table 5 [Table 6] shall not exceed 8%. The minimum weight [mass] is controlled by thickness tolerance and minimum pattern height.

12.2 *Pattern*—The minimum height of the raised pattern figures is 0.040 in. [1.00 mm]. (The pattern figure height is the difference in thickness between the maximum thickness reading to the top of the figure and the thickness of an adjacent nonfigured area.) The top of the raised figure may be rounded with sloping sides. A definite line of demarcation between the figure top and sides is not required. The pattern orientation shall conform to Fig. 1.

12.3 *Width, Length, Pattern Line Camber, Lateral Bow, and Squareness*—Tread plate shall not vary in width, length, pattern line camber, lateral bow, or squareness by more than the permissible variations prescribed in the following tables of ANSI H35.2 [H35.2M]:

Table No.	Title
7.2	Width
7.3	Length
7.6	Camber of Pattern Line
7.7	Lateral Bow
7.8	Squareness

12.4 *Thickness*—The thickness shall be that permitted by the respective tolerances shown in Table 7 [Table 8].

12.5 *Sampling for Inspection*—Examination for dimensional conformance shall be made to ensure conformance to the tolerance specified. On approval of the purchaser, a system of statistical quality control for such sampling and examinations may be used.

13. Source Inspection

13.1 If the purchaser desires that his representative inspect or witness the inspection and testing of the material prior to

TABLE 4 Bend Diameter Factors^A

Thickness, in. [mm]	Factor, <i>N</i>			
	3003 H231	6061 Temper O	6061 Tempers T4, T42	6061 Tempers T6, T62
0.100 [2.50]	2	2	4	7
0.125 [3.20]	2	2	4	7
0.156 [4.00]	2	2	4	7
0.188 [5.00]	2 ^B	2	4	7
0.250 [6.00]		4	5	8
... [8.00]		4	6	8
0.375 [10.00]		4	6	8
0.500 [12.00]		4	6	8
0.625 [16.00]		4	6	8

^A See 10.1.

^B The 3003-H231 product at this thickness is capable of the 2t bend but bending may produce an objectionable surface condition

TABLE 5 Nominal Weights per Square Foot

Specified Thickness	Nominal Weight —lb./ft. ²	
	Inches	
0.100	3003	6061
0.125	1.57	1.55
0.156	1.92	1.90
0.188	2.36	2.34
0.250	2.82	2.79
0.313	---	3.67
0.375	---	4.56
0.500	---	5.43
0.625	---	7.20
		8.96

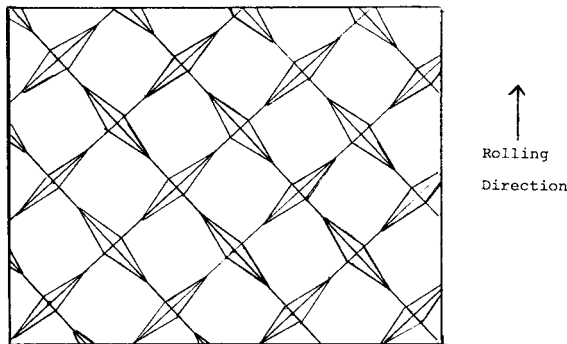
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TABLE 6 Nominal Mass per Square Meter

Specified Thickness mm	Nominal Weight —kg/m ²	
	3003	6061
2.50	7.4	7.4
3.20	9.3	9.3
4.00	11.5	11.5
5.00	14.2	14.2
6.00	---	16.9
8.00	---	22.3
10.00	---	27.7
12.00	---	33.1
16.00	---	43.9

TABLE 8 Thickness Tolerances

Specified Thickness ^A mm	3003 Tolerance mm		6061 Tolerance mm	
	Plus	Minus	Plus ^B	Minus
2.50	0.15	0.15	0.20	0.30
3.20	0.21	0.21	0.26	0.38
4.00	0.26	0.26	0.28	0.48
5.00	0.26	0.26	0.35	0.60
6.00	---	---	0.42	0.72
8.00	---	---	0.56	0.96
10.00	---	---	0.70	1.20
12.00	---	---	0.84	1.40
16.00	---	---	1.10	1.90



NOTE 1—Length of diamond: 1³/₁₆ in. [31 mm] maximum. Width of diamond: 1¹/₃₂ in. [9 mm] maximum.

FIG. 1 Pattern Orientation of Raised Figures (Previously Known as Pattern B)

TABLE 7 Thickness Tolerances

Specified Thickness ^A Inches	3003 Tolerance Inches		6061 Tolerance Inches	
	Plus	Minus	Plus ^B	Minus
0.100	0.006	0.006	0.008	0.012
0.125	0.009	0.009	0.010	0.015
0.156	0.010	0.010	0.011	0.019
0.188	0.010	0.010	0.013	0.023
0.250	---	---	0.018	0.030
0.313	---	---	---	---
0.375	---	---	0.025	0.045
0.500	---	---	0.035	0.060
0.625	---	---	0.044	0.075

^ASpecified thickness does not include height of pattern.
^BIn case of dispute, allowed plus tolerance shall be determined by weight.

shipment, such agreement shall be made by the purchaser and producer as part of the purchase contract.

13.2 When such inspection or witness of inspection and testing is agreed upon, the purchaser's representative shall be afforded 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.

14. Retest and Rejection

14.1 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.

14.2 When there is evidence that a failed specimen was not representative of the inspection lot and when no other sampling

^ASpecified thickness does not include height of pattern.
^BIn case of dispute, allowed plus tolerance shall be determined by weight.

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.

14.3 Material in which non conforming conditions are discovered subsequent to inspection may be rejected.

14.4 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 by the purchaser.

15. Identification Marking of Product

15.1 Identification marking of this product is normally not required. When marking is necessary and when specified on the purchase order or contract, all sheet and plate shall be marked on the back side in accordance with Practice B 666/B 666M or by identifying each sheet or plate near one end on the back side with the producer's name or trademark, alloy, temper, thickness, and this specification number.

16. Packaging and Package Marking

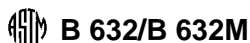
16.1 The material shall be packaged to provide adequate protection during normal handling and transportation and each package shall contain only one size, alloy, and temper of material unless otherwise agreed. The type of packaging and gross weight [mass] of containers shall, unless otherwise agreed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

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

16.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B 660.

17. Certification

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



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. Metric mechanical property limits in this issue were derived from the inch-pound system limits that were developed under the above principles. As test data on metric dimensioned specimens are accumulated, some refinement of limits, particularly for elongations measured in 5D, can be anticipated.

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 or H35.1M. The Aluminum Association⁸ 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 or H35.1M. 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.

⁸ The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.

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SUMMARY OF CHANGES

- | | |
|--|---|
| (1) Added 3003–H231 tread product to document. | (8) Table 2, Added 3003-H231 limits. |
| (2) Updated referenced documents in Section 2. | (9) Table 3, Added 3003-H231 limits. |
| (3) Revised Section 3 on Terminology | (10) Table 4, Added 3003-H231 bend factors and new Foot-note. |
| (4) Revised ordering information in Section 4. | (11) Table 5 and Table 6, Added 3003 values, created separate metric table. |
| (5) Section 8. Revised heat treatment information. | (12) Table 7 and Table 8, Added 3003 values, created separate metric table. |
| (6) Section 11. Revised response to heat treatment requirements. | |
| (7) Table 1, Added 3003 composition. | |

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