



Standard Specification for Aluminum-Alloy Rolled Tread Plate¹

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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 | |
| | | | | | | |
| 3003-H231 | 0.100-0.113 | 19.0 | ... | 15.0 | ... | 5 |
| | 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 |
| | 0.100-0.249 | 30.0 | ... | 14.0 | ... | 14 |
| 6061-T42 ^E | 0.250-0.625 | 30.0 | ... | 14.0 | ... | 16 |
| | 0.100-0.188 | 42.0 | ... | 35.0 | ... | 6 |
| | 0.189-0.249 | 42.0 | ... | 35.0 | ... | 8 |
| 6061-T6 and T62 ^E | 0.250-0.499 | 42.0 | ... | 35.0 | ... | 10 |
| | 0.500-0.625 | 42.0 | ... | 35.0 | ... | 9 |
| | 0.100-0.625 | no requirements | ... | ... | ... | ... |
| 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