



Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube¹

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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 extruded structural pipe and tube in those selected alloys shown in [Table 1](#) and tempers shown in [Table 2](#), and in those standard sizes shown in [Tables 3-5](#), as well as in other nonstandard sizes as agreed upon between the purchaser and supplier. Such pipe and tube is intended for use in structural applications such as highway and bridge rails, chain-link fence posts, handrails, sign structures, awning supports, lighting brackets, etc. Structural pipe and tube is not intended for fluid-carrying applications involving pressure.

NOTE 1—For drawn seamless tube used in pressure applications see Specifications [B210](#) and [B210M](#), for seamless pipe and seamless extruded tube used in pressure applications see Specifications [B241/B241M](#), and for drawn tube and pipe for general purpose applications see Specification [B483/B483M](#).

1.2 Alloy and temper designations are in accordance with ANSI [H35.1/H35.1\(M\)](#). The equivalent Unified Numbering System alloy designations are those of [Table 1](#) preceded by A9, for example, A96061 for alloy 6061 in accordance with Practice [E527](#).

1.3 For acceptance criteria for inclusion of new aluminum and aluminum alloys in this specification, see [Annex A2](#).

1.4 *Units*—The values stated in either inch-pound units or SI units are to be regarded separately as standard. SI units are shown in brackets. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the specification.

1.4.1 While this standard is a combined SI and inch-pound standard, standard pipe sizes are not applicable to SI units, therefore non-rationalized SI units (soft conversions) are shown for reader convenience. Rationalized [hard converted] SI units are shown in brackets while non-rationalized (soft converted) SI units are shown in parentheses.

1.5 *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.

2. Referenced Documents

2.1 ASTM Standards:²

- [B210](#) Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes
- [B210M](#) Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes (Metric)
- [B241/B241M](#) Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube
- [B483/B483M](#) Specification for Aluminum and Aluminum-Alloy Drawn Tube and Pipe for General Purpose Applications
- [B557](#) Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
- [B557M](#) Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)
- [B660](#) Practices for Packaging/Packing of Aluminum and Magnesium Products
- [B666/B666M](#) Practice for Identification Marking of Aluminum and Magnesium Products
- [B807/B807M](#) Practice for Extrusion Press Solution Heat Treatment for Aluminum Alloys
- [B881](#) Terminology Relating to Aluminum- and Magnesium-Alloy Products
- [B918](#) Practice for Heat Treatment of Wrought Aluminum Alloys
- [B945](#) Practice for Aluminum Alloy Extrusions Press Cooled from an Elevated Temperature Shaping Process for Production of T1, T2, T5 and T10–Type Tempers
- [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
- [E527](#) Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

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 For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

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

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

Alloy Designation	Silicon	Iron	Copper	Manganese	Magnesium	Chromium	Zinc	Titanium	Other Elements ^E		Aluminum
									Each	Total ^F	
6005	0.6-0.9	0.35	0.10	0.10	0.40-0.6	0.10	0.10	0.10	0.05	0.15	Remainder
6005A ^G	0.50-0.9	0.35	0.30	0.50	0.40-0.7	0.30	0.20	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
6063	0.20-0.6	0.35	0.10	0.10	0.45	0.10	0.10	0.10	0.05	0.15	remainder
6082	0.7-1.3	0.50	0.10	0.40-1.0	0.6-1.2	0.25	0.20	0.10	0.05	0.15	Remainder
6105	0.6-1.0	0.35	0.10	0.15	0.45-0.8	0.10	0.10	0.10	0.05	0.15	Remainder

^A Limits are in 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 method of Practice E29.

^D In case there is a discrepancy in the values listed in Table 1 with those listed in the International Alloy Designations and Chemical Composition Limits for Wrought Aluminum and Wrought Aluminum Alloys (commonly known as the "Teal Sheets", the composition limits registered with The Aluminum Association and published in the "Teal Sheets" should be considered the controlling composition. The "Teal Sheets" are available at <http://www.aluminum.org/tealsheets>.

^E *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.

^F *Other Elements*—Total shall be the sum of unspecified metallic elements 0.010 % or more, rounded to the second decimal before determining the sum.

^G 0.12-0.50 Mn+Cr

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere

E716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis

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

2.2 *ANSI Standards:*

H35.1/H35.1(M) Alloy and Temper Designations Systems for Aluminum³

H35.2 Dimensional Tolerance for Aluminum Mill Products³

H35.2(M) Dimensional Tolerance for Aluminum Mill Products [Metric]³

2.3 *Military Standard:*

MIL-STD-129 Marking for Shipment and Storage⁴

2.4 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)⁴

2.5 *EN Standards*

CEN EN 14242 Aluminum and Aluminum Alloys, Chemical Analysis, Inductively Coupled Plasma Optical Emission Spectral Analysis⁵

3. Terminology

3.1 *Definitions*—Refer to Terminology B881 for definitions of product terms used in this specification.

3.2 *Metric Sizes*—Note that while this is a combined SI and Metric Units Specification, there are no standard equivalent metric designations for Pipe. Metric sizes are converted and shown only for user convenience.

4. Ordering Information

4.1 Purchase orders (Orders) for material to this specification shall include the following information:

³ Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, <http://www.aluminum.org>.

⁴ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://dodssp.daps.dla.mil>.

⁵ Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

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

4.1.2 Quantity in pieces, pounds, or feet,

4.1.3 Size and schedule number for pipe; outside diameter and wall thickness for extruded tube (see Tables 3-5), and length in feet,

4.1.4 Alloy (Section 8) and temper (Section 9),

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

4.2.1 Whether inspection or witness of inspection and tests by the purchaser's representative is required prior to material shipment (Section 13),

4.2.2 Whether certification of the material by the manufacturer is required (Section 15),

4.2.3 Whether marking for identification is required and whether marking in accordance with B666/B666M is required (Section 16),

4.2.4 Whether Practices B660 applies and, if so, the levels of preservation, packaging, and packing required (Section 17), and

4.2.5 Whether heat treatment in accordance with Practice B918 is required (10.3).

5. Materials and Manufacture

5.1 The pipe or tube may be produced by extrusion through a bridge/porthole-type die or by other methods at the option of the producer, provided that the resulting products comply with the requirements in this specification.

6. Special Characteristics

6.1 Unless otherwise specified, the pipe or tube shall be supplied with square-cut ends.

7. Responsibility for Quality Assurance

7.1 *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



TABLE 2 Tensile Property Limits^{A,B,C}

Alloy-Temper	Specified Wall Thickness, in. [mm]	Tensile Strength, min, ksi [MPa] ^D	Yield Strength, min, ksi [MPa] ^D	Elongation, min, %		
				In 2 in. or 4 × Diameter ^E	In 50 mm ^F	In 5 × Diameter (5.65 √A) ^F
6005-T1	Up thru 0.500 [Up thru 12.5]	25.0 [170]	15 [105]	16	16	14
6005-T5	Up thru 0.124 [Up thru 3.20]	38.0 [260]	35.0 [240]	8	8	
	0.125-1.000 [3.20-25.0]	38.0 [260]	35.0 [240]	10	10	9
6005A-T1	Up thru 0.249 [Up thru 6.30]	25.0 [170]	14.5 [100]	15	15	...
6005A-T5	Up thru 0.249 [Up thru 6.30]	38.0 [260]	31.0 [215]	7	7	...
	0.250-0.999 [6.30-25.00]	38.0 [260]	31.0 [215]	9	9	8
6005A-T61	Up thru 0.249 [Up thru 6.30]	38.0 [260]	35.0 [240]	8	8	...
	0.250-1.000 [6.30-25.00]	38.0 [260]	35.0 [240]	10	10	9
6061-0	All	22.0 [150] max	16.0 [110] max	16	16	
6061-T1	Up thru 0.625	26.0 [180]	14.0 [95]	16	16	
6061-T4, T4510, T4511	All	26.0 [180]	16.0 [110]	16	16	14
6061-T6, T62, T6510, T6511	Up thru 0.249 [Up thru 6.30]	38.0 [260]	35.0 [240]	8	8	...
	0.250 and over [over 6.30]	38.0 [260]	35.0 [240]	10	10	9
6063-0	All	19 [130] max	...	18	18	
6063-T1	Up thru 0.500 [Up thru 12.50]	17.0 [115]	9.0 [60]	12	12	
	0.501-1.000 [12.50- 25.00]	16.0 [110]	8.0 [55]	12	12	
6063-T4, T42	Up thru 0.500 [Up thru 12.50]	19.0 [130]	10.0 [70]	14	14	12
	0.501-1.000 [over 12.50 thru 25.00]	18.0 [125]	9.0 [60]	14	...	12
6063-T5	Up thru 0.500 [Up thru 12.50]	22.0 [150]	16.0 [110]	8	8	
	0.501-1.000 [12.50- 25.00]	21.0 [145]	15.0 [105]	8	8	
6063-T52	Up thru 1.000 [Up thru 25.00]	22.0 [150] 30 [205] max	16.0 [110]- 25.0 [170] max	8	8	
6063-T6, T62	Up thru 0.124 [Up thru 3.20]	30.0 [205]	25.0 [170]	8	8	...
	0.125-1.000 [over 3.20 thru 25.00]	30.0 [205]	25.0 [170]	10	10	9
6082-T6, T6511	0.200-1.000 [5.00-25.00]	45.0 [310]	38.0 [260]	8	8	7
6105-T1	Up thru 0.500 [Up thru 12.50]	25.0 [170]	15.0 [105]	16	16	14
6105-T5	Up thru 0.500 [Up thru 12.50]	38.0 [260]	35.0 [240]	8	8	7

^A To determine conformance to this specification, each value for tensile strength and for yield strength shall be rounded-off to the nearest 0.1 ksi and each value for elongation to the nearest 0.5 percent, both in accordance with the rounding-off method of Practice E29.

^B Specimens shall be tested parallel to the direction of working.

^C The basis for establishment of mechanical property limits is shown in Annex A1.

^D For explanation of the SI unit MPa, see Appendix X1.

^E Elongation of full-section and cut-out sheet-type specimens is measured in 2 in., of cut-out round specimens, in 4 × specimen diameter.

^F Elongations in 50 mm apply for tube and pipe tested in full section and for sheet-type specimens machined from material up through 12.5 mm thickness having parallel surfaces. Elongation in 5D (5.65 √A) where D and A are diameter and cross-sectional area of the specimen respectively, apply to round test specimens machined from thicknesses over 12.5 mm.

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 ensure that material conforms to prescribed requirements.

7.2 Lot Definition—An inspection lot shall consist of an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions traceable to a heat-treat lot or lots, and subjected to inspection at one time.

8. Chemical Composition

8.1 Limits—The material shall conform to the chemical composition limits specified in Table 1. Conformance shall be determined by the producer by taking samples in accordance with E716 when the ingots are poured, and analyzing those samples in accordance with E607, E1251, E34 or EN 14242. At least one sample shall be taken for each group of ingots poured simultaneously from the same source of molten metal. If the producer has determined the chemical composition during