



## Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles<sup>1</sup>

This standard is issued under the fixed designation B308/B308M; 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 ( $\epsilon$ ) 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<sup>2</sup> covers extruded 6061-T6 aluminum-alloy standard structural profiles.
- 1.2 The profiles are limited to I-beams, H-beams, channels, angles, tees, and zeeks.

NOTE 1—For other extruded profiles in other alloys and tempers refer to Specification B221.

1.3 Alloy and temper designations are in accordance with ANSI H35.1/~~H35.1M~~ and ~~ANSI H35.1(M)~~. The equivalent Unified Numbering System alloy designation is that in Table 1 preceded by A9, or A96061 for alloy 6061 in accordance with Practice E527.

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

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

1.6 *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 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:*<sup>3</sup>

- B221 Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
- 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)
- B647 Test Method for Indentation Hardness of Aluminum Alloys by Means of a Webster Hardness Gage
- B648 Test Method for Indentation Hardness of Aluminum Alloys by Means of a Barcol Impressor
- 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
- D3951 Practice for Commercial Packaging
- E18 Test Methods for Rockwell Hardness of Metallic Materials
- 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
- ~~E55 Practice for Sampling Wrought Nonferrous Metals and Alloys for Determination of Chemical Composition~~
- E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

<sup>1</sup> 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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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications see related Specification SB-308 in Section II of that Code.

<sup>3</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto: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<sup>A,B,C</sup>**

Alloy 6061	Composition, %
Silicon	0.40–0.8
Iron	0.7
Copper	0.15–0.40
Manganese	0.15
Magnesium	0.8–1.2
Chromium	0.04–0.35
Zinc	0.25
Titanium	0.15
Other elements <sup>D</sup> each	0.05
Total <sup>E</sup>	0.15
Aluminum	remainder

<sup>A</sup> Where single units are shown, these indicate the maximum amounts permitted.

<sup>B</sup> Analysis shall be made for the elements for which limits are shown in this table.

<sup>C</sup> 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 of figures used in expressing the specified limit, in accordance with the rounding-off method of Practice E29.

<sup>D</sup> *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.

<sup>E</sup> *Other Elements*—Total shall be the sum of unspecified metallic elements 0.010 % or more, rounded to the second decimal before determining the sum.

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

2.3 *ANSI Standards:*

H35.1H35.1/H35.1M Alloy and Temper Designation Systems for Aluminum<sup>4</sup> H35.1(M) Alloy and Temper Designation Systems for Aluminum (Metric)<sup>4</sup>

H35.2 Dimensional Tolerances for Aluminum Mill Products<sup>4</sup>

H35.2(M)H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)<sup>4</sup>

2.4 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)<sup>5</sup>

2.5 *AMS Specifications:*

AMS 2772 Heat Treatment of Aluminum Alloy/Raw Materials<sup>6</sup>

2.6 *Military Specifications:*

MIL-STD-129 Marking for Shipment and Storage<sup>5</sup>

2.7 *CEN EN Standards:*

EN 14242 Aluminum and aluminum alloys, Chemical analysis inductively coupled plasma optical emission spectral analysis.<sup>7</sup>

### 3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *inspection lot*—an identifiable quantity of material of the same mill form, alloy, temper, and nominal dimensions traceable to a heat-treat lot of lots, subjected to inspection at one time (see 14.1).

3.2.2 *heat-treat lot*—an identifiable quantity of material heat-treated in the same furnace at the same time (see 10.2.1 and 10.2.2).

### 4. Ordering Information

4.1 Orders for material to this specification shall include the following information:

<sup>4</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>4</sup> Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, <http://www.aluminum.org>.

<sup>5</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS; 19111-5098, <http://dodssp.daps.dla.mil>.

<sup>6</sup> Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001.

<sup>6</sup> Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

<sup>7</sup> The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.

<sup>7</sup> 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),

NOTE 2—For inch-pound orders specify B308; for metric orders specify B308M. Do not mix units.

4.1.2 Quantity in pieces or pounds [kilograms],

4.1.3 Alloy (Section 8),

4.1.4 Temper (10.1 and Table 2),

4.1.5 Type of section (1.2), dimensions (including a drawing if necessary), 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 solution heat treatment at the extrusion press is unacceptable (9.2),

4.2.2 Whether heat treatment in accordance with Practice B918 is required (9.3),

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

4.2.4 Whether certification of the material by the supplier is required (Section 15),

4.2.5 Whether marking for identification is required (16.1) and whether marking of lot number is required (16.2), and

4.2.6 Whether Practices B660 applies and, if so, the applicable levels of preservation, packaging, and packing required (17.3).

## 5. Materials and Manufacture

5.1 The products covered by this specification shall be produced by hot extruding only.

## 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 ensure that material conforms to prescribed requirements.

## 7. General Quality

7.1 Unless otherwise specified, the structural profiles 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 purchaser.

7.2 Each profile shall be examined to determine conformance to this specification with respect to general quality and identification marking. On approval of the purchaser, however, the producer or the supplier may use a system of statistical quality control for such examination.

## 8. Chemical Composition

8.1 *Limits*—The structural profiles shall conform to the chemical composition limits specified in Table 1. Conformance shall be determined by the producer by analyzing samples taken at the time the ingots are poured, or samples taken from the finished or semifinished product. If the producer has determined the chemical composition of the material 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 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.

**TABLE 2 Tensile Property Limits<sup>A,B</sup>**

6061-T6	
Tensile strength, min, ksi [MPa]	38.0 [260]
Yield strength, min, ksi [MPa]	35.0 [240]
Elongation, <sup>C</sup> min, %	
in 2 in. [50 mm]	10 [10] <sup>D</sup>
in 4D [5D or 5.65 $\sqrt{A}$ ]	10 [9]

<sup>A</sup> For purposes of determining conformance with this specification, each value for tensile strength and yield strength shall be rounded to the nearest 0.1 ksi [1 MPa], and each value for elongation shall be rounded to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.

<sup>B</sup> The basis for mechanical property limits is given in Annex A1.

<sup>C</sup> Elongations in 2 in. [50 mm] apply for profiles tested in full section and for sheet-type specimens machined from material up through 0.500 in. [12.5 mm] in thickness having parallel surfaces. Elongations in 4D [5D or 5.65  $\sqrt{A}$ ], where D and A are diameter and cross-sectional area of the specimen, respectively, apply to round test specimens machined from thicknesses over 0.250 in. [6.30 mm].

<sup>D</sup> For thicknesses less than 0.250 in. [up through 6.30 mm] the minimum elongation is 8 %.

~~8.2~~*Number of Samples*—The number of samples taken for determination of chemical composition shall be as follows:

~~8.2.1~~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.

~~8.2.2~~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.

~~8.3~~*Methods of Sampling*—Samples for determination of chemical composition shall be taken in accordance with one of the following methods:

~~8.3.1~~Samples for chemical analysis shall be taken from the material by drilling, sawing, milling, turning, or clipping a representative piece or pieces to obtain a weight of prepared sample not less than 75 g. Sampling shall be in accordance with Practice E55.

~~8.3.2~~Sampling for spectrochemical analysis shall be in accordance with Practices —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 . Samples for other methods of analysis shall be suitable for the form of material being analyzed and the type of analytical method used:

~~8.4~~*Methods of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E34) or spectrochemical (Test Methods when the ingots are poured, and analyzing those samples in accordance with E607 and , E1251) methods. Other methods may be used only when no published ASTM test method is available. In case of dispute, the methods of analysis shall be agreed upon between the producer and purchaser. , 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 pouring of the ingots, they shall not be required to sample and analyze the finished product.

~~8.2~~ *Methods of Sampling*—If it becomes necessary to analyze an extrusion for conformance to chemical composition limits, the method used to sample an extrusion for the determination of chemical composition shall be by agreement between the producer and the purchaser. Analysis shall be performed in accordance with E716, E607, E1251, E34, or EN 14242 (ICP method). The number of samples taken for determination of chemical composition shall be as follows:

~~8.2.1~~ When samples are taken from finished or semi-finished product, a sample shall be taken to represent each 4000 lb [2000 kg] or fraction thereof of material in the shipment, except that not more than one sample shall be required per piece.

~~8.3~~ Other methods of analysis or in the case of dispute may be by agreement between the producer and the purchaser.

~~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.

## 9. Heat Treatment

~~9.1~~Except as noted in

~~9.1~~ Except as noted in 9.2, or otherwise specified in 9.3, producer or supplier heat treatment shall be in accordance with AMS 2772.

~~9.2~~ *Material*Unless otherwise specified, material may be solution heat-treated and quenched at the extrusion press in accordance with Practice B807/B807M.

~~9.3~~ When specified, heat treatment shall be in accordance with Practice B918.

## 10. Tensile Properties

10.1 *Limits*—The structural profiles shall conform to the tensile requirements specified in Table 2.

10.1.1 The elongation requirements shall not be applicable to the following:

10.1.1.1 Material of such dimensions that a standard test specimen cannot be taken in accordance with Test Methods B557 or B557M and of such profile that it cannot be satisfactorily tested in full section.

10.1.1.2 Material less than 0.062 in. [up through 1.60 mm] in thickness.

10.2 *Number of Specimens*:

10.2.1 For material having a nominal weight of less than 1 lb/linear ft [up through 1.7 kg/linear m], one tension test specimen shall be taken for each 1000 lb [500 kg] or fraction thereof in the heat-treat lot.

10.2.2 For material having a nominal weight of 1 lb or more/linear ft [over 1.7 kg/linear m], one tension test specimen shall be taken for each 1000 ft [300 m] or fraction thereof in the heat-treat lot.

10.2.3 Other procedures for selecting samples may be employed if agreed upon by the producer and the purchaser.

10.3 *Test Specimens*:

10.3.1 *Tension Specimens*—Tension test specimens shall conform to Test Methods B557 or B557M.

10.4 *Test Method*:

10.4.1 *Tension Tests*— The tension test shall be made in accordance with Test Methods B557 or B557M.

## 11. Quality Assurance Screening of Extrusion Press Heat-Treated Shapes

11.1 For 6061-T6 shapes that are manufactured by quenching at the extrusion press, the requirements of this section shall apply in addition to all other applicable requirements of this specification. Hardness tests shall be performed either on each extruded