Designation: B308/B308M – 10

Used in USAEC-RDT Standards

Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles[1]

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 (ε) indicates an editorial change since the last revision or reapproval.

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

1. Scope*

1.1 This specification[2] covers extruded 6061-T6 aluminum-alloy standard structural profiles.

1.2 The profiles are limited to I-beams, H-beams, channels, angles, tees, and zees.

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. 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 SI units or inch-pound units are to be regarded separately as standard. 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 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:*[3]

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

E527 Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)[4]

E716 Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis

[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 ASME Boiler and Pressure Vessel Code applications see related Specification SB-308 in Section II of that Code.

[3] 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.

[4] The last approved version of this historical standard is referenced on www.astm.org.

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

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

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[D] each	0.05
Total[E]	0.15
Aluminum	remainder

[A] Where single units are shown, these indicate the maximum amounts permitted.
[B] Analysis shall be made for the elements for which limits are shown in this table.
[C] 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.
[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.

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

2.3 *ANSI Standards:*

H35.1/H35.1M Alloy and Temper Designation Systems for Aluminum[5]

H35.2 Dimensional Tolerances for Aluminum Mill Products[5]

H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)[5]

2.4 *Federal Standard:*

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)[6]

2.5 *AMS Specifications:*

AMS 2772 Heat Treatment of Aluminum Alloy/Raw Materials[7]

2.6 *Military Specifications:*

MIL-STD-129 Marking for Shipment and Storage[6]

2.7 *CEN EN Standards:*

EN 14242 Aluminum and aluminum alloys, Chemical analysis inductively coupled plasma optical emission spectral analysis.[8]

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:

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

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.

TABLE 2 Tensile Property Limits[A,B]

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

[A] 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.
[B] The basis for mechanical property limits is given in Annex A1.
[C] 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].
[D] For thicknesses less than 0.250 in. [up through 6.30 mm] the minimum elongation is 8 %.

[5] Available from Aluminum Association, Inc., 1525 Wilson Blvd., Suite 600, Arlington, VA 22209, http://www.aluminum.org.
[6] Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, http://dodssp.daps.dla.mil.
[7] Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, http://www.sae.org.
[8] Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, http://www.cenorm.be.

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 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 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 9.2, or otherwise specified in 9.3, producer or supplier heat treatment shall be in accordance with AMS 2772.

9.2 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 charge or on a sample selected in accordance with a sampling plan as specified on purchase orders. The minimum hardness control value shall be in accordance with Table 3 for the type of hardness tester used. The specific type of hardness tester used shall be the producer's choice. The test shall be conducted in accordance with the applicable hardness test standard, namely Test Method B647 for Webster hardness, Test Method B648 for Barcol hardness, or Test Methods E18 for Rockwell E hardness.

11.2 Individual extruded charges that fail to conform to the requirements of Table 3 may be accepted provided the two

TABLE 3 Hardness Screening Values[A,B,C]

Thickness		Hardness Number, min		
in.	mm	Webster	Barcol	Rockwell E
0.050 through 0.075	over 1.20 through 2.00	15	76	89
0.076 through 0.499	over 2.00 through 12.50	15	76	90
0.500 and over	over 12.50	...	76	...

[A] See Section 11.
[B] Alternate minimum hardness values and hardness testing devices may be used provided that agreement is reached between the purchaser and the supplier or producer.
[C] The hardness values shown do not guarantee material will pass the applicable mechanical property requirements but are for informational purposes only. It is the responsibility of the user of this specification to establish the relationship between the hardness values and tensile properties.

pieces in the lot having the two lowest hardness readings are tension-tested and found to conform to the requirements of Table 2.

12. Dimensional Tolerances

12.1 Variations from the specified or nominal dimensions shall not exceed the permissible variations prescribed in the following tables of ANSI H35.2 and ANSI H35.2M:

Table No.	Title
11.2,3,4	Cross-Sectional Dimensions
11.5	Length
11.6	Straightness
11.7	Twist
11.8,9	Flatness (Flat Surfaces)
11.10	Surface Roughness
11.11	Contour (Curved Surfaces)
11.12	Squareness of Cut Ends
11.13	Corner and Fillet Radii
11.14	Angularity

13. Source Inspection

13.1 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.

13.2 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.

14. Rejection and Retest

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 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 defects 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.

15. Certification

15.1 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.

16. Identification Marking of Product

16.1 When marking for identification is required (see 4.2.5), all material shall be marked in accordance with Practice B666/B666M.

17. Packaging and Package Marking

17.1 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 upon. The type of packaging and gross weight of containers shall, unless otherwise agreed upon, be at the producer'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.

17.2 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's name or trademark.

17.3 When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B660. 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 and Practice D3951 for civil agencies and MIL-STD-129 for military agencies.

18. Keywords

18.1 aluminum alloy; standard structural profiles

ANNEXES

(Mandatory Information)

A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

A1.1 Mechanical property limits are established in accord with Section 6, Standards Section, of the most current edition of the Aluminum Standards and Data and the latest edition of the Aluminum Association publication "Tempers for Aluminum and Aluminum Alloy Products (Yellow and Tan Sheets)".

A1.1.1 Limits are based on a statistical evaluation of the data indicating that at least 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits are based on the statistical analyses of at least 100 tests from at least 5 cast lots of standard production material with no more than 10 observations from a given heat treat or inspection lot. Mechanical properties limits for press solution heat treated products have specific additional requirements which are provided in the "Tempers for Aluminum and Aluminum Alloy Products". All tests are performed in accordance with the appropriate ASTM test methods.

A1.1.2 Limits denoted as "Tentative" by the Aluminum Association may be included. Requirements for tentative property registrations are defined in the latest edition of the Aluminum Association publication "Tempers for Aluminum and Aluminum Alloy Products". Tentative property limits are established at levels at which at least 99 % of the data conform at a confidence level of 95 %. Tentative property limits, which are subject to revision, shall be based on a statistical analysis of at least 30 tests from at least 3 cast lots of standard production material with no more than 10 observations from a given heat treat or inspection lot. Where tentative property limits are listed, they shall be shown in italics and footnoted as Tentative in the standard.

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/H35.1(M). The Aluminum Association[5] 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/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; Titanium (Note A2.1); 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 Titanium and Other Elements, Each or are specified in footnotes.

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

SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B308/B308M – 02) that may impact the use of this standard. (Approved May 1, 2010.)

(1) Updated last revision date in footnote to 2002,
(2) Section 2, Deleted reference to E55 for chemical testing, added reference to EN 14242, Combined reference line for H35.1 and H35.1(M), Added missing footnote for source for H35 documents; added source for EN 14242, Corrected footnote for the Aluminum Association.
(3) Replaced Section 8 with standard wording for Chemical Testing.
(4) Section 12, Corrected table numbers and added 11.11 for Contour (Curved Surfaces).
(5) Section 16, Deleted 16.2 since B666 now requires lot numbers in stenciling.
(6) Replaced Annex 1 language with updated version.
(7) Corrected Table 2 elongations to be consistent with AS&D Table 11.1.
(8) Section 8, Replaced chemical analysis with standard wording.
(9) Section 9, revised 9.2 to be consistent with wording in other documents.