



Designation: B618/B618M – 18<sup>ε1</sup>

## Standard Specification for Aluminum-Alloy Investment Castings<sup>1</sup>

This standard is issued under the fixed designation B618/B618M; 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 U.S. Department of Defense.*

<sup>ε1</sup> NOTE—Footnote C of Table 3 was revised editorially in August 2018.

### 1. Scope\*

1.1 This specification covers aluminum-alloy investment castings designated as shown in [Table 1](#).

1.2 This specification is for aluminum-alloy investment castings used in general purpose applications. It may not address the mechanical properties integrity testing and verification required for highly loaded or safety critical applications.

1.3 Alloy and temper designations are in accordance with ANSI H35.1/H35.1 (M).

1.4 Unless the order specifies the “M” specification designation, the material shall be furnished to the inch-pound units.

1.5 For acceptance criteria for inclusion of new aluminum and aluminum alloys and their properties in this specification, see [Annex A1](#) and [Annex A2](#).

1.6 *Units*—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 nonconformance with the standard.

1.7 *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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.8 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

### 2. Referenced Documents

2.1 The following documents of the issue in effect on the date of purchase form a part of this specification to the extent referenced herein:

2.2 *ASTM Standards*:<sup>2</sup>

[B179 Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes](#)

[B275 Practice for Codification of Certain Zinc, Tin and Lead Die Castings](#)

[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](#)

[B881 Terminology Relating to Aluminum- and Magnesium-Alloy Products](#)

[B917/B917M Practice for Heat Treatment of Aluminum-Alloy Castings from All Processes](#)

[B985 Practice for Sampling Aluminum Ingots, Billets, Castings and Finished or Semi-Finished Wrought Aluminum Products for Compositional Analysis](#)

[D3951 Practice for Commercial Packaging](#)

[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 \(Withdrawn 2017\)](#)<sup>3</sup>

[E94 Guide for Radiographic Examination Using Industrial Radiographic Film](#)

[E155 Reference Radiographs for Inspection of Aluminum and Magnesium Castings](#)

<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 B07.01 on Aluminum Alloy Ingots and Castings.

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<sup>2</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.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

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

**TABLE 1 Chemical Composition Requirements<sup>A,B,C,D</sup>**

Desig <sup>J</sup>	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Ag	Be	Pb	Sn	Zr	FNs	Others <sup>F</sup>		Al. Min.
																Each	Total <sup>F</sup>	
201.0	0.10	0.15	4.0-5.2	0.20-0.50	0.15-0.55	...	...	...	0.15-0.35	0.40-1.0	...	...	...	...	...	0.05	0.10	Rem.
204.0	0.20	0.35	4.2-5.0	0.10	0.15-0.35	...	0.05	0.10	0.15-0.30	...	...	...	0.05	...	...	0.05	0.15	Rem.
242.0	0.7	1.0	3.5-4.5	0.35	1.2-1.8	0.25	1.7-2.3	0.35	0.25	...	...	...	0.05	...	...	0.05	0.15	Rem.
295.0	0.7-1.5	1.0	4.0-5.0	0.35	0.03	...	...	0.35	0.25	...	...	...	...	...	...	0.05	0.50	Rem.
319.0	5.5-6.5	1.0	3.0-4.0	0.50	0.10	...	0.35	1.0	0.25	...	...	...	...	...	...	...	0.50	Rem.
328.0	7.5-8.5	1.0	1.0-2.0	0.20-0.6	0.20-0.6	0.35	0.25	1.5	0.25	...	...	...	...	...	...	...	0.15	Rem.
355.0	4.5-5.5	0.6 <sup>G</sup>	1.0-1.5	0.50 <sup>G</sup>	0.40-0.6	0.25	...	0.35	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
C355.0	4.5-5.5	0.20	1.0-1.5	0.10	0.40-0.6	...	...	0.10	0.20	...	...	...	...	...	...	0.05	0.15	Rem.
356.0	6.5-7.5	0.6 <sup>G</sup>	0.25	0.35 <sup>G</sup>	0.20-0.45	...	...	0.35	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
A356.0	6.5-7.5	0.20	0.20	0.10	0.25-0.45	...	...	0.10	0.20	...	...	...	...	...	...	0.05	0.15	Rem.
A443.0	4.5-6.0	0.8	0.30	0.50	0.05	0.25	...	0.50	0.25	...	...	...	...	...	...	0.05	0.35	Rem.
B443.0	4.5-6.0	0.8	0.15	0.35	0.05	...	...	0.35	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
514.0	0.35	0.50	0.15	0.35	3.5-4.5	...	...	0.15	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
520.0	0.25	0.30	0.25	0.15	9.5-10.6	...	...	0.15	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
535.0	0.15	0.15	0.05	0.10-0.25	6.2-7.5	...	...	...	0.10-0.25	...	0.003-0.007	...	...	0.005B	...	0.05	0.15	Rem.
705.0	0.20	0.8	0.20	0.40-0.6	1.4-1.8	0.20-0.40	...	...	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
707.0	0.20	0.8	0.20	0.40-0.6	1.8-2.4	0.20-0.40	...	2.7-3.3	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
710.0 <sup>I</sup>	0.15	0.50	0.35-0.6	0.05	0.6-0.8	...	...	4.0-4.5	0.25	...	...	...	...	...	...	0.05	0.15	Rem.
712.0 <sup>I</sup>	0.30	0.50	0.25	0.10	0.50-0.65 <sup>H</sup>	0.40-0.6	...	6.0-7.0	0.25	...	...	...	...	...	...	0.05	0.20	Rem.
713.0	0.25	1.1	0.40-1.0	0.6	0.20-0.50	0.35	0.15	5.0-6.5	0.15-0.25	...	...	...	...	...	...	0.05	0.25	Rem.
771.0	0.15	0.15	0.10	0.10	0.8-1.0	0.06-0.20	...	6.5-7.5	0.10-0.20	...	...	...	...	...	...	0.05	0.15	Rem.
850.0	0.7	0.7	0.7-1.3	0.10	0.10	...	0.7-1.3	...	0.20	...	...	...	5.5-7.0	...	...	...	0.30	Rem.
851.0 <sup>I</sup>	2.0-3.0	0.7	0.7-1.3	0.10	0.10	...	0.3-0.7	...	0.20	...	...	...	5.5-7.0	...	...	...	0.30	Rem.
852.0 <sup>I</sup>	0.40	0.7	1.7-2.3	0.10	0.6-0.9	...	0.9-1.5	...	0.20	...	...	...	5.5-7.0	...	...	...	0.30	Rem.

<sup>A</sup> When single units are shown, they 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> The following applies to all specified limits in this table: 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> In case of discrepancy between the values listed in Table 1 and those listed in the "Designations and Composition Limits for Aluminum Alloys in the Form of Castings and Ingot (known as the 'Pink Sheets')", the composition limits registered with the Aluminum Association and published in the "Pink Sheets" shall be considered the controlling composition.

<sup>E</sup> "Others" 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 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>F</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.

<sup>G</sup> If iron exceeds 0.45 %, manganese content shall not be less than one half of the iron content.

<sup>H</sup> The Aluminum Association ruling on the number of decimal places to which Mg percent is expressed is exempted for some long standing alloys. See A2.2.6.

<sup>I</sup> 710.0 formerly A712.0, 712.0 formerly D712.0, 851.0 formerly A850.0, 852.0 formerly B850.0.

<sup>J</sup> For a cross reference of current and former alloy designations see the Aluminum Association's "Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot (The Pink Sheets)."

**E165** Practice for Liquid Penetrant Examination for General Industry

**E607** Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point to Plane Technique Nitrogen Atmosphere (Withdrawn 2011)<sup>3</sup>

**E716** Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spark Atomic Emission Spectrometry

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

**E2422** Digital Reference Images for Inspection of Aluminum Castings

**IEEE/ASTM SI 10** Standard for Use of the International System of Units (SI): The Modern Metric System

2.3 *ANSI Standard*:<sup>4</sup>

**H35.1/H35.1 (M)-2006** American National Standard Alloy and Temper Designation Systems for Aluminum

2.4 *Military Standards*:<sup>5</sup>

**MIL-STD-129** Marking for Shipment and Storage

**MIL-STD-276** Impregnation of Porous Nonferrous Metal Castings

2.5 *Federal Standard*:

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

2.6 *AMS Standard*:<sup>6</sup>

**AMS 2771** Heat Treatment of Aluminum Alloy Castings

2.7 *NAVSEA Standard*:<sup>7</sup>

**S9074-AR-GIB-010/278** Requirements for Fabrication Welding and Inspection, and Casting Inspection and Repair for Machinery, Piping, and Pressure Vessels

2.8 *Aluminum Association Standard*:<sup>4</sup>

Designations and Chemical Composition Limits for Aluminum Alloys in the Form of Castings and Ingot (The Pink Sheets)

2.9 *Other Standards*:<sup>8</sup>

**CEN EN 14242** Aluminum and Aluminum Alloys—Chemical Analysis—Inductively Coupled Plasma Optical Emission Spectral Analysis

after which the pattern is removed through the use of heat, and then filling the resulting cavity with molten metal and allowing it to solidify.

#### 4. Ordering Information

4.1 Orders for material under this specification shall include the following information (1.4 and 1.6):

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

NOTE 1—For inch-pound application, specify Specification B618 and for metric application specify Specification B618M. Do not mix units.

4.1.2 Alloy (Section 7 and Table 1),

4.1.3 Temper (Section 10 and Table 2 [Table 3]),

4.1.4 Applicable drawing or part number, and

4.1.5 The quantity in either pieces or pounds [kilograms].

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

4.2.1 Whether chemical analysis and tensile property reports are required (Table 1 and Table 2 [Table 3]),

4.2.2 Whether castings, test specimens, or both may be supplied in the artificially aged – T5 temper for alloys 705.0, 707.0, 712.0, and 713.0 (10.2),

4.2.3 Whether test specimens cut from castings are required in addition to or instead of separately cast specimens (10.3 and 11.2),

4.2.4 Whether heat treatment is to be performed in accordance with AMS 2771 (Section 15),

4.2.5 Whether repairs are permissible (16.1),

4.2.6 Whether inspection is required at the producer's works (18.1),

4.2.7 Whether surface requirements shall be checked against observational standards where such standards are established (19.1),

4.2.8 Whether liquid penetrant inspection is required (19.3),

4.2.9 Whether radiographic inspection is required and, if so, the radiographic grade of casting required (19.4 and Table 4),

4.2.10 Whether certification is required (21.1),

4.2.11 Whether foundry control is required (Section 9),

4.2.12 Whether Practices B660 apply and, if so, the levels of preservation, packaging, and packing required (24.4), and

4.2.13 Whether marking in accordance with Fed. Std. No. 123, Practice D3951, or MIL-STD 129 applies (24.4).

#### 5. Responsibility for Quality Assurance

5.1 *Responsibility for Inspection and Tests*—Unless otherwise specified in the contract or purchase order, the producer shall be 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 other suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. 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 confirm that material conforms to prescribed requirements.

#### 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 *investment casting, n*—a metal object produced by surrounding (investing) an expendable pattern (usually wax or plastic) with a refractory slurry that sets at room temperature,

<sup>4</sup> Available from Aluminum Association, Inc., 1400 Crystal Drive Suite 430 Arlington, VA 22202, <http://www.aluminum.org>.

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

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

<sup>7</sup> Available from Naval Sea Systems Command (NAVSEA), 1333 Isaac Hull Ave., SE, Washington, DC 20376, <http://www.navsea.navy.mil>.

<sup>8</sup> Available from European Committee for Standardization (CEN), 36 Rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.