



Designation: B85/B85M – 18<sup>ε1</sup>

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

This standard is issued under the fixed designation B85/B85M; 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 X2.2 was revised editorially in August 2018.

### 1. Scope\*

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

1.2 This specification is for aluminum-alloy die 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 non-conformance 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.*

<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.

Current edition approved May 1, 2018. Published May 2018. Originally approved in 1931. Last previous edition approved in 2014 as B85/B85M – 14. DOI: 10.1520/B0085\_B0085M-18E01.

### 2. Referenced Documents

2.1 The following documents of the issue in effect on date of order acceptance 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 \(Withdrawn 2020\)](#)<sup>3</sup>

[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](#)

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

[D3951 Practice for Commercial Packaging](#)

[E8/E8M Test Methods for Tension Testing of Metallic Materials](#)

[E23 Test Methods for Notched Bar Impact Testing 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 \(Withdrawn 2017\)](#)<sup>3</sup>

[E505 Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings](#)

[E607 Test Method for Atomic Emission Spectrometric](#)

<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 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>E</sup>		Al Min.
																Each	Total <sup>F</sup>	
360.0 <sup>G</sup>	9.0–10.0	2.0	0.6	0.35	0.40–0.6	...	0.50	0.50	...	...	...	...	0.15	...	...	...	0.25	Rem.
A360.0 <sup>K</sup>	9.0–10.0	1.3	0.6	0.35	0.40–0.6	...	0.50	0.50	...	...	...	...	0.15	...	...	...	0.25	Rem.
380.0 <sup>G</sup>	7.5–9.5	2.0	3.0–4.0	0.50	0.10	...	0.50	3.0	...	...	...	...	0.35	...	...	...	0.50	Rem.
A380.0 <sup>H,K</sup>	7.5–9.5	1.3	3.0–4.0	0.50	0.10	...	0.50	3.0	...	...	...	...	0.35	...	...	...	0.50	Rem.
383.0 <sup>H</sup>	9.5–11.5	1.3	2.0–3.0	0.50	0.10	...	0.30	3.0	...	...	...	...	0.15	...	...	...	0.50	Rem.
384.0 <sup>H</sup>	10.5–12.0	1.3	3.0–4.5	0.50	0.10	...	0.50	3.0	...	...	...	...	0.35	...	...	...	0.50	Rem.
390.0	16.0–18.0	1.3	4.0–5.0	0.10	0.45–0.65 <sup>I</sup>	...	...	0.10	0.20	...	...	...	...	...	...	0.10	0.20	Rem.
B390.0	16.0–18.0	1.3	4.0–5.0	0.50	0.45–0.65 <sup>I</sup>	...	0.10	1.5	0.20	...	...	...	...	...	0.10	0.20	Rem.	
392.0	18.0–20.0	1.5	0.40–0.8	0.20–0.6	0.8–1.2	...	0.50	0.50	0.20	...	...	...	0.30	...	0.15	0.50	Rem.	
413.0 <sup>G</sup>	11.0–13.0	2.0	1.0	0.35	0.10	...	0.50	0.50	...	...	...	...	0.15	...	...	...	0.25	Rem.
A413.0 <sup>K</sup>	11.0–13.0	1.3	1.0	0.35	0.10	...	0.50	0.50	...	...	...	...	0.15	...	...	...	0.25	Rem.
C443.0 <sup>G</sup>	4.5–6.0	2.0	0.6	0.35	0.10	...	0.50	0.50	...	...	...	...	0.15	...	...	...	0.25	Rem.
518.0 <sup>G</sup>	0.35	1.8	0.25	0.35	7.5–8.5	...	0.15	0.15	...	...	...	...	0.15	...	...	...	0.25	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 registration or 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> The sum of those “Others” metallic elements 0.010 % or more each, expressed to the second decimal before determining the sum  
<sup>G</sup> Alloys 360.0, 380.0, 413.0, C443.0 and 518.0 are suitable for the production of die casting by either the hot-chamber or the cold-chamber process. Die castings of alloys A360.0, A380.0, 383.0, 384.0, and A413.0 may be made only in cold-chamber machines.  
<sup>H</sup> With respect to mechanical properties, alloys A380.0, 383.0 and 384.0 are substantially interchangeable.  
<sup>I</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>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’)”.  
<sup>K</sup> A360.1, A380.1, and A413.1 ingot is used to produce 360.0 and A360.0; 380.0 and A380.0; 413.0 and A413.0 castings, respectively.

<https://standards.iteh.ai>

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

**2.3 ANSI Standard:**

**H35.1/H35.1(M)-2006 American National Standard Alloy and Temper Designation Systems for Aluminum<sup>4</sup>**

**2.4 NADCA Product Specification Standards for Die Castings:<sup>5</sup>**

- Engineering and Design: Coordinate Dimensioning**
- S-4A-1-15 Linear Dimensions: Standard Tolerances**
- S-4A-2-15 Parting Line: Standard Tolerances**
- S-4A-3-15 Moving Die Components (MDC): Standard Tolerances**
- S-4A-4-15 Draft Requirements: Standard Tolerances**
- S-4A-5-15 Flatness Requirements: Standard Tolerances**
- S-4A-6-15 Cored Holes for Cut Threads: Standard Tolerances**

**S-4A-8-15 Cored Holes for Pipe Threads: Standard Tolerances**

- P-4A-1-15 Linear Dimensions: Precision Tolerances**
- P-4A-2-15 Parting Line: Precision Tolerances**
- P-4A-3-15 Moving Die Components (MDC): Precision Tolerances**
- P-4A-4-15 Draft Requirements: Precision Tolerances**
- P-4A-5-15 Flatness Requirements: Precision Tolerances**
- P-4A-6-15 Cored Holes for Cut Threads: Precision Tolerances**
- P-4A-7-15 Cored Holes for Formed Threads: Precision Tolerances**
- S/P-4-9-15 Machining Stock Allowances (Standard and Precision) Engineering and Design: Additional Specification Guidelines**
- G-6-1-15 Pressure Tightness in Die Cast Parts**
- G-6-2-15 Fillets, Ribs and Corners in Die cast Parts (1 of 2)**
- G-6-3-15 Fillets, Ribs and Corners in Die cast Parts (2 of 2)**
- G-6-4-15 Ejector Pins, Pin Marks and Pin Flash**
- G-6-5-15 Casting Flash removal**
- G-6-6-15 Surface Finish, As Cast**
- G-6-7-15 Die Cast Lettering and Ornamentation**

**2.5 Federal Standard:<sup>6</sup>**

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

<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>5</sup> Available from North American Die Casting Association (NADCA), 241 Holbrook Dr Wheeling, Illinois 60090-5809, <http://www.diecasting.org/>

<sup>6</sup> Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://www.dodssp.daps.mil>.

2.6 *Military Standard*.<sup>6</sup>

**MIL-STD-129** Marking for Shipment and Storage (Military Agencies)

2.7 *Aluminum Association Standard*.<sup>7</sup>

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

2.8 *Other Standard*.<sup>8</sup>

**EN 14242** Aluminum and Aluminum Alloys – Chemical Analysis – inductively Coupled plasms Optical Emission Spectral Analysis

### 3. Terminology

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

### 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 application, specify Specification B85 and for metric application specify Specification B85M. Do not mix units.

4.1.2 The quantity in either pieces or pounds [kilograms],

4.1.3 Part name and number,

4.1.4 Alloy (see Section 8 and **Table 1**), and

4.1.5 Drawing of die casting, when required, giving all necessary dimensions and showing latest revisions and allowances for linear dimensions (10.2), parting lines (10.3), moving die components (10.4), draft (10.5), flatness (10.6), cored hole threads (10.7 – 10.9), and machining stock (10.10). Location of ejector pin marks or parting lines shall be at the option of the producer; unless specifically designated on the drawing.

4.2 Additional tests, options and special inspection requirements as provided below should be justified only on the basis of need. These shall be specified in the contract or purchase order, as additional procedures and extended delivery time may be involved.

4.2.1 Whether chemical analysis reports are required (8.3 and **Table 1**),

4.2.2 Whether additional quality assurance requirements are required (7.1),

4.2.3 Whether special proof tests or mechanical property tests are required (Section 9),

4.2.4 Whether there are additional general quality requirements for internal soundness (11.2), pressure tightness (11.3), fillets, ribs and corners (11.4), ejector pins, pin marks, pin flash and flash removal (11.5), casting flash removal (11.6), surface finish (11.7), die cast lettering and ornamentation (11.8) or workmanship (11.10),

4.2.5 Whether source inspection is required (Section 12),

4.2.6 Whether certification is required (Section 14),

4.2.7 Marking for identification (Section 15), and

4.2.8 Whether marking in accordance with Fed. Std. 123 or ASTM **D3951** (16.2) or MIL-STD-129 applies (16.2).

4.2.9 Whether Practices **B660** applies and, if so, the levels of preservation, packaging and packing required (16.4),

### 5. Materials

5.1 Unless otherwise specified, only aluminum alloy conforming to the requirements of Specification **B179** or producer's foundry scrap (identified as being made from alloy conforming to Specification **B179**) shall be used in the remelting furnace from which molten metal is taken for pouring directly into castings. Additions of small amounts of modifiers and grain refining elements or alloys are permitted.

5.1.1 Pure materials, recycled materials, and master alloys and material not conforming to Specification **B179** may be used to make alloys conforming to this specification, provided chemical analysis can be taken and adjusted to conform to **Table 1** prior to pouring any castings.

### 6. Manufacture

6.1 The responsibility of furnishing die castings that can be laid out and machined to the final dimensions within the permissible variations specified, as shown on the blueprints or drawings, shall rest with the producer, except when the die is furnished by the purchaser.

### 7. Quality Assurance

7.1 *Responsibility for Inspection*—When specified in the contract or purchase order, the producer or supplier is responsible for the performance of all inspection and test requirements specified herein. Except as otherwise specified in the contract or order, the producer or supplier 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. Quality assurance standards shall be agreed upon between the producer or supplier and purchaser at the time a contract or order is placed.

7.2 *Lot Definition*—An inspection lot shall be defined as follows:

7.2.1 An inspection lot shall consist of the production from each die or compound die on each machine for each 24 h during the first week of normal operation and the production for each 48 h thereafter of normal operation. Any significant change in the machine, composition, die or continuity of operation shall be considered as the start of a new lot. Die castings inspected by this method shall be so marked or handled during the finishing operations as not to lose their identity.

7.2.2 Each die casting of a randomly selected sample shall be examined to determine conformance to the requirements with respect to general quality, dimensions, and identification marking. The producer or supplier may use a system of statistical quality control for such examinations.

7.3 All testing shall be performed in accordance to applicable ASTM test methods.

<sup>7</sup> Available from Aluminum Association, Inc., 1400 Crystal Drive Suite 430 Arlington, VA 22202, <http://www.aluminum.org>.

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

## 8. Chemical Composition

8.1 The product shall conform to the requirements as to chemical composition prescribed in **Table 1**. Conformance shall be determined by the producer by analyzing samples taken at the time castings are poured in accordance with Practice **E716** and analyzed in accordance with Test Methods **E34**, **E607**, or **E1251**, or EN 14242. If the producer has determined the chemical composition of the metal during the course of manufacture, he shall not be required to sample and analyze the finished product.

8.1.1 A sample for determination of chemical composition shall be taken to represent one of the following:

8.1.2 For production runs of less than 8 h, one sample from each die or compound die on each machine.

8.1.3 For production runs of more than 8 hours, one sample from each die or compound die on each machine every 8 h.

8.2 If it becomes necessary to analyze castings for conformance to chemical composition limits, the method used to sample castings for the determination of chemical composition shall be in accordance with Practice **B985**. Analysis shall be performed in accordance with Practice **E716**, Test Methods **E34**, **E607**, or **E1251**, or EN 14242 (ICP method).

8.3 When a chemical analysis is required with a shipment, it shall be called for in the contract or purchase order.

8.4 If the producer's or supplier's method of composition control is acceptable, sampling for chemical analysis may be waived at the discretion of the purchaser.

8.5 By agreement, an appropriate spectrographic sample may be prepared at time of manufacture.

## 9. Mechanical Properties

9.1 Unless specified in the contract or purchase order or specifically guaranteed by the manufacturer, acceptance of die castings under these specifications shall not depend on mechanical properties determined by tension or impact tests. **Table X2.1** [**Table X2.2**] shows typical mechanical properties that may be expected of test specimens when cast in a separate tensile test bar die and that conform to the chemical composition specified. When tension or impact tests are made, the tension test specimen shown in Fig. 18 of Test Methods **E8/E8M** or Fig. 13 of Test Methods **B557** or **B557M**, and the Type 'A' Charpy Impact Test Specimen with the V notch cast into the specimen shown in Fig. 1 of Test Methods **E23** shall be used.

9.2 When specified in the contract or purchase order, die castings shall withstand proof tests without failure as defined by agreement between the purchaser and the producer or supplier.

## 10. Dimensions, Mass, and Permissible Variations

10.1 Permissible variations in dimensions shall be within the limits specified on the drawings or in the contract or purchase order.

10.2 *Linear Dimensions*—Unless otherwise specified on the drawing or in the contract or purchase order, linear dimension tolerances shall conform to NADCA Product Specification

Standard S-4A-1-15, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-1-15, Precision Tolerances.

10.3 *Parting Lines*—Unless otherwise specified on the drawing or in the contract or purchase order, parting line dimension tolerances shall conform to NADCA Product Specification Standard S-4A-2-15, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-2-15, Precision Tolerances.

10.4 *Moving Die Components*—Unless otherwise specified on the drawing or in the contract or purchase order, moving die component dimension tolerances shall conform to NADCA Product Specification Standard S-4A-3-15, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-3-15, Precision Tolerances.

10.5 *Draft*—Unless otherwise specified on the drawing or in the contract or purchase order, draft tolerance dimensions shall conform to NADCA Product Specification Standard S-4A-4-15, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-4-15, Precision Tolerances.

10.6 *Flatness*—Unless otherwise specified on the drawing or in the contract or purchase order, flatness dimensional tolerances shall conform to NADCA Product Specification Standard S-4A-5-15, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-5-15, Precision Tolerances.

10.7 *Cored Holes for Cut Threads*—Unless otherwise specified on the drawing or in the contract or purchase order, the dimensional tolerances for cored holes for cut threads shall conform to NADCA Product Specification Standard S-4A-6-15, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-6-15, Precision Tolerances.

10.8 *Cored Holes for Pipe Threads*—Unless otherwise specified on the drawing or in the contract or purchase order, the dimensional tolerances for cored holes for cut threads shall conform to NADCA Product Specification Standard S-4A-8-15.

10.9 *Cored Holes for Formed Threads*—Unless otherwise specified on the drawing or in the contract or purchase order, the dimensional tolerances for cored holes for cut threads shall conform to NADCA Product Specification Standard P-4A-7-15.

10.10 *Machining Stock*—Unless otherwise specified on the drawing or in the contract or purchase order, allowances for machining stock shall conform to the standard tolerances detailed in NADCA Product Specification Standard S/P-4-9-15, or by agreement between the producer and the supplier, the precision tolerances shown in S/P-4-9-15.

10.11 Dimensional tolerance deviations waived by the purchaser shall be confirmed in writing to the producer or supplier.

## 11. General Quality

11.1 Imperfections inherent in die castings shall not be cause for rejection provided it is demonstrated that the die castings are in accordance with the requirements and standards agreed upon.