



Designation: B85/B85M – 13

Standard Specification for Aluminum-Alloy Die Castings¹

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 (ϵ) 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 covers aluminum-alloy die castings of all compositions. Thirteen of the most commonly die cast alloy compositions are specified, designated as shown in [Table 1](#).

1.2 This specification is not intended for aluminum-alloy die castings used in aerospace applications.

1.3 Alloy and temper designations are in accordance with ANSI H35.1/H35.1(M). The equivalent unified numbering system alloy designations are in accordance with Practice [E527](#).

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 and health practices and determine the applicability of regulatory requirements prior to use.*

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:²

- [B179](#) Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes
- [B275](#) Practice for Codification of Certain Nonferrous Metals and Alloys, Cast and Wrought
- [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
- [B881](#) Terminology Relating to Aluminum- and Magnesium-Alloy Products
- [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
- [E505](#) Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings
- [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)³
- [E716](#) Practices for Sampling and Sample Preparation of Aluminum and Aluminum Alloys for Determination of Chemical Composition by Spectrochemical Analysis
- [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

¹ 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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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.

³ 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 Requirements^{A,B,C}

Designation ^D														Others ^E		
AA No. (ANSI)	(old) ASTM	UNS	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Sn	Each	Total ^F	Aluminum	
360.0	SG100B	A03600	9.00-10.00	2.00	0.60	0.35	0.4-0.60	...	0.50	0.50	...	0.15	...	0.25	Remainder	
A360.0	SG100A	A13600	9.00-10.00	1.30	0.60	0.35	0.40-0.60	...	0.50	0.50	...	0.15	...	0.25	Remainder	
380.0	SC84B	A03800	7.50-9.50	2.00	3.00-4.00	0.50	0.10	...	0.50	3.00	...	0.35	...	0.50	Remainder	
A380.0 ^G	SC84C	A13800	7.50-9.50	1.30	3.00-4.00	0.50	0.10	...	0.50	3.00	...	0.35	...	0.50	Remainder	
383.0 ^G	SC102A	A03830	9.50-11.50	1.30	2.00-3.00	0.50	0.10	...	0.30	3.00	...	0.15	...	0.50	Remainder	
384.0 ^G	SC114A	A03840	10.50-12.00	1.30	3.00-4.50	0.50	0.10	...	0.50	3.00	...	0.35	...	0.50	Remainder	
390.0	SC174A	A03900	16.00-18.00	1.30	4.00-5.00	0.10	0.45-0.65	0.10	0.20	...	0.10	0.20	Remainder	
B390.0	SC174B	A23900	16.00-18.00	1.30	4.00-5.00	0.50	0.45-0.65	...	0.10	1.50	0.20†	...	0.10	0.20	Remainder	
392.0	S19	A03920	18.00-20.00	1.50	0.40-0.80	0.20-0.60	0.80-1.20	...	0.50	0.50	0.20	0.30	0.15	0.50	Remainder	
413.0	S12B	A04130	11.00-13.00	2.00	1.00	0.35	0.10	...	0.50	0.50	...	0.15	...	0.25	Remainder	
A413.0	S12A	A14130	11.00-13.00	1.30	1.00	0.35	0.10	...	0.50	0.50	...	0.15	...	0.25	Remainder	
C443.0	S5C	A34430	4.50-6.00	2.00	0.60	0.35	0.10	...	0.50	0.50	...	0.15	...	0.25	Remainder	
518.0	G8A	A05180	0.35	1.80	0.25	0.35	7.50-8.50	...	0.15	0.15	...	0.15	...	0.25	Remainder	

† Corrected editorially in August 2013.

^A Analysis shall ordinarily be made only for the elements mentioned in this table. If, however, the presence of other elements is suspected, or indicated in the course of routine analysis, further analysis shall be made to determine that the total of these other elements are not present in excess of specified limits.

^B For purposes of acceptance and rejection, the observed value or calculated value obtained from analysis should be rounded off to the nearest unit in the last right-hand place of figures, used in expressing the specified limit, in accordance with the rounding procedure prescribed in Section 3 of Practice E29.

^C Limits are in percent maximum unless shown otherwise.

^D 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. ASTM designations were established in accordance with Practice B275. ANSI designations were established in accordance with ANSI H35.1/H35.1 (M). UNS designations were established in accordance with Practice E527.

^E "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 "other" elements. Should any analysis by the producer or the purchaser establish that the aggregate of several "others" elements exceeds the limit of the "Total" the material shall be considered non-conforming.

^F The sum of those "others" metallic elements 0.010 percent or more, each expressed to the second decimal before determining the sum.

^G With respect to mechanical properties, alloys A380.0, 383.0 and 384.0 are substantially interchangeable.

2.3 AMS Standard:

[AMS-STD-184 Identification Marking of Aluminum, Magnesium and Titanium⁴](#)

2.4 ANSI Standard:

[H35.1/H35.1\(M\)-2006 American National Standard Alloy and Temper Designation Systems for Aluminum⁵](#)

2.5 NADCA Product Specification Standards for Die Castings:⁶

[Engineering and Design: Coordinate Dimensioning](#)

[S-4A-1-09 Linear Dimensions: Standard Tolerances](#)

[S-4A-2-09 Parting Line: Standard Tolerances](#)

[S-4A-3-09 Moving Die Components \(MDC\): Standard Tolerances](#)

[S-4A-4-09 Draft Requirements: Standard Tolerances](#)

[S-4A-5-09 Flatness Requirements: Standard Tolerances](#)

[S-4A-6-09 Cored Holes for Cut Threads: Standard Tolerances](#)

[S-4A-8-09 Cored Holes for Pipe Threads: Standard Tolerances](#)

[P-4A-1-09 Linear Dimensions: Precision Tolerances](#)

[P-4A-2-09 Parting Line: Precision Tolerances](#)

[P-4A-3-09 Moving Die Components \(MDC\): Precision Tolerances](#)

[P-4A-4-09 Draft Requirements: Precision Tolerances](#)

[P-4A-5-09 Flatness Requirements: Precision Tolerances](#)

[P-4A-6-09 Cored Holes for Cut Threads: Precision Tolerances](#)

[P-4A-7-09 Cored Holes for Formed Threads: Precision Tolerances](#)

[S/P-4-9-09 Machining Stock Allowances \(Standard and Precision\) Engineering and Design: Additional Specification Guidelines](#)

[G-6-1-09 Pressure Tightness in Die Cast Parts](#)

[G-6-2-09 Fillets, Ribs and Corners in Die cast Parts \(1 of 2\)](#)

[G-6-3-09 Fillets, Ribs and Corners in Die cast Parts \(2 of 2\)](#)

[G-6-4-09 Ejector Pins, Pin Marks and Pin Flash](#)

[G-6-5-09 Casting Flash removal](#)

[G-6-6-09 Surface Finish, As Cast](#)

[G-6-7-09 Die Cast Lettering and Ornamentation](#)

2.6 Federal Standard:

[Fed. Std. No. 123 Marking for Shipment \(Civil Agencies\)⁷](#)

2.7 Military Standard:

[MIL-STD-129 Marking for Shipment and Storage \(Military Agencies\)⁷](#)

2.8 Other Standards:⁸

[EN 14242 Aluminum and Aluminum Alloys – Chemical Analysis – inductively Coupled plasma Optical Emission Spectral Analysis](#)

3. Terminology

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

⁴ Available from SAE AEROSPACE, 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://aerospace.sae.org>.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁶ Available from North American Die Casting Association (NADCA), 241 Holbrook Dr Wheeling, Illinois 60090-5809, <http://www.diecasting.org/>

⁷ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://www.dodssp.daps.mil>.

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

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 (8.5 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 (16.3),

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.

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 E716 and analyzed in accordance with E607, E1251, E34 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.

8.2 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 by agreement between the producer and the purchaser. Analysis shall be performed in accordance with E716, E607, E1251, E34 or EN 14242 (ICP method).

8.3 Other methods of analysis or in the case of a dispute the method of analysis shall be agreed upon by the producer and the purchaser.

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

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

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

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

8.6 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.

8.7 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-1-09, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-1-09, 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-2-09, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-2-09, 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-3-09, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-3-09, 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-4-09, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-4-09, 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-5-09, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-5-09, 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-6-09, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-6-09, 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-8-09.

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-7-09.

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-4-9-09, or by agreement between the producer and the supplier, the precision tolerances shown in S/P-4-9-09.

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.

11.2 *Internal Soundness*—When specified, the soundness of die castings shall conform to standards or requirements agreed upon between the producer or supplier and the purchaser. The number and extent of imperfections shall not exceed those specified by the purchaser. The standards or requirements may consist of radiographs in accordance with Reference Radiographs **E505**, photographs or sectioned die castings.

11.3 *Pressure Tightness*—When specified in the contract or purchase order, the pressure tightness of die castings shall conform to standards agreed upon between the purchaser and the producer or supplier, or as prescribed in NADCA Product Specification Standards for Die Castings G-6-1-09.

11.4 *Fillets, Ribs and Corners*—Unless otherwise specified in the contract or purchase order fillets, ribs and corners shall