



Designation: B 85 – 03

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

This standard is issued under the fixed designation B 85; 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 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 Alloy and temper designations are in accordance with ANSI H35.1. The equivalent unified numbering system alloy designations are in accordance with Practice E 527.

1.3 For acceptance criteria for inclusion of new aluminum and aluminum alloys and their properties in this specification, see Annex A1 and Annex A2.

1.4 *Units*—The values stated in inch-pound units are to be regarded as the standard. The values given in parentheses are mathematical conversions to SI units which are provided for information only and are not considered standard.

1.5 *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:

B 179 Specification for Aluminum Alloys in Ingot and Molten Forms for Castings from All Casting Processes<sup>2</sup>

B 275 Practice for Codification of Certain Nonferrous Metals and Alloys, Cast and Wrought<sup>2</sup>

B 557 Test Methods of Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products<sup>2</sup>

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products<sup>2</sup>

B 881 Terminology Relating to Aluminum- and Magnesium-Alloy Products<sup>2</sup>

<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> *Annual Book of ASTM Standards*, Vol 02.02.

D 3951 Practice for Commercial Packaging<sup>3</sup>

E 8 Test Methods for Tension Testing of Metallic Materials<sup>4</sup>

E 23 Test Methods for Notched Bar Impact Testing of Metallic Materials<sup>4</sup>

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications<sup>5</sup>

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys<sup>6</sup>

E 88 Practice for Sampling Nonferrous Metals and Alloys in Cast Form for Determination of Chemical Composition<sup>6</sup>

E 505 Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings<sup>7</sup>

E 527 Practice for Numbering Metals and Alloys (UNS)<sup>8</sup>

E 607 Test Method for Atomic Emission Spectrometric Analysis Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere<sup>6</sup>

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis<sup>6</sup>

E 1251 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge<sup>6</sup>

2.3 *AMS Standard:* 311550a68e/astm-b85-03  
AMS-STD-184 Identification Marking of Aluminum, Magnesium and Titanium<sup>9</sup>

2.4 *ANSI Standard:*

H35.1 Alloy and Temper Designation Systems for Aluminum<sup>10</sup>

2.5 *NADCA Product Specification Standards for Die Castings:*<sup>11</sup>

Engineering and Design: Coordinate Dimensioning

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 15.09.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>6</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>7</sup> *Annual Book of ASTM Standards*, Vol 03.03.

<sup>8</sup> *Annual Book of ASTM Standards*, Vol 01.01.

<sup>9</sup> Available from SAE AEROSPACE, 400 Commonwealth Dr., Warrendale, PA 15096-0001.

<sup>10</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

<sup>11</sup> Available from North American Die Casting Association (NADCA), 9701 W. Higgins Rd., Suite 880, Rosemont, IL 60018-4721.

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

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

Designation <sup>D</sup>													Others <sup>E</sup>		
AA No. (ANSI)	(old) ASTM	UNS	Si	Fe	Cu	Mn	Mg	Cr	Ni	Zn	Ti	Sn	Each	Total <sup>F</sup>	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 <sup>G</sup>	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 <sup>G</sup>	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 <sup>G</sup>	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	0.10	...	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

<sup>A</sup> 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.

<sup>B</sup> 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 E 29.

<sup>C</sup> Limits are in percent maximum unless shown otherwise.

<sup>D</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. ASTM designations were established in accordance with Practice B 275. ANSI designations were established in accordance with ANSI H35.1. UNS designations were established in accordance with Practice E 527.

<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 "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.

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

<sup>G</sup> With respect to mechanical properties, alloys A380.0, 383.0 and 384.0 are substantially interchangeable.

- S-4A-1-00 Linear Dimensions: Standard Tolerances
- S-4A-2-00 Parting Line: Standard Tolerances
- S-4A-3-00 Moving Die Components (MDC): Standard Tolerances
- S-4A-4-00 Draft Requirements: Standard Tolerances
- S-4A-5-00 Flatness Requirements: Standard Tolerances
- S-4A-6-00 Cored Holes for Cut Threads: Standard Tolerances
- S-4A-8-00 Cored Holes for Pipe Threads: Standard Tolerances
- P-4A-1-00 Linear Dimensions: Precision Tolerances
- P-4A-2-00 Parting Line: Precision Tolerances
- P-4A-3-00 Moving Die Components (MDC): Precision Tolerances
- P-4A-4-00 Draft Requirements: Precision Tolerances
- P-4A-5-00 Flatness Requirements: Precision Tolerances
- P-4A-6-00 Cored Holes for Cut Threads: Precision Tolerances
- P-4A-7-00 Cored Holes for Formed Threads: Precision Tolerances
- S/P-4-9-00 Machining Stock Allowances (Standard and Precision) Engineering and Design: Additional Specification Guidelines
- G-6-1-00 Pressure Tightness in Die Cast Parts
- G-6-2-00 Fillets, Ribs and Corners in Die cast Parts (1 of 2)
- G-6-3-00 Fillets, Ribs and Corners in Die cast Parts (2 of 2)
- G-6-4-00 Ejector Pins, Pin Marks and Pin Flash
- G-6-5-00 Casting Flash removal
- G-6-6-00 Surface Finish, As Cast
- G-6-7-00 Die Cast Lettering and Ornamentation

2.6 *Federal Standard:*

- Fed. Std. No. 123 Marking for Shipment (Civil Agencies)<sup>12</sup>
- 2.7 *Military Standard:*
- MIL-STD-129 Marking for Shipment and Storage (Military Agencies)<sup>12</sup>

### 3. Terminology

3.1 *Definitions*—Refer to Terminology B 881 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),
- 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.

<sup>12</sup> Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

4.2.1 Whether chemical analysis reports are required (8.1.1 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 the material shall be packaged, or marked, or both, in accordance with MIL-STD-129, Fed. Std. No. 123 or Practice D 3951 (16.2), and Practices B 660 (16.3).

## 5. Materials

5.1 Unless otherwise specified, only aluminum alloy conforming to the requirements of Specification B 179 or producer's foundry scrap (identified as being made from alloy conforming to Specification B 179) 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 B 179 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 producer of the die castings shall supply castings that can be laid out and machined to the final dimensions (within the permissible variations specified on the blueprints or drawings), 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 *Limits*—The diecastings 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 made. 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 When a chemical analysis is required with a shipment, it shall be called for in the contract or purchase order.

8.1.2 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.

8.2 *Number of Samples*—When required, samples for determination of chemical composition shall be taken to represent the following:

8.2.1 A sample shall be taken from each of two representative castings selected from each defined lot (see 7.2.1).

8.3 *Methods of Sampling*—Samples from die castings 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 prepared sample not less than 100 g. Sampling shall be in accordance with Practices E 88 or E 716, or both.

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

8.4 *Method of Analysis*—The determination of chemical composition shall be made in accordance with suitable chemical (Test Methods E 34), or spectrochemical (Test Methods E 607 and E 1251) 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 the purchaser.

## 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 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 E 8 or Fig. 13 of

Test Methods B 557, and the impact test specimen shown in Fig. 6 of Test Methods E 23 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-1-00, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-1-00, 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-2-00, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-2-00, 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-3-00, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-3-00, 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-4-00, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-4-00, 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-5-00, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-5-00, 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-6-00, Standard Tolerances, or by agreement between the producer and the supplier, P-4A-6-00, 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-8-00.

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-7-00.

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-4-9-00, or by agreement between the producer and the supplier, the precision tolerances shown in S/P-4-9-00.

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 E 505, 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-6-1-00.

11.4 *Fillets, Ribs and Corners*—Unless otherwise specified in the contract or purchase order fillets, ribs and corners shall conform to NADCA Product Specification Standards for Die Castings G-6-2-00 and G-6-3-00.

11.5 *Ejector Pins, Pin Marks, Pin Flash, and Flash Removal*—Unless otherwise specified in the contract or purchase order ejector pins, pin marks, pin flash, and flash removal shall conform to NADCA Product Specification Standards for Die Castings G-6-4-00 and G-6-5-00.

11.6 *Casting Flash Removal*—Unless otherwise specified in the contract or purchase order casting flash removal shall conform to NADCA Product Specification Standards for Die Castings G-6-5-00.

11.7 *Surface Finish*—When specified in the contract or purchase order the as-cast surface finish required 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-6-6-00.

11.8 *Die Cast Lettering and Ornamentation*—Unless otherwise specified in the contract or purchase order, die cast lettering and ornamentation shall conform to NADCA Product Specification Standards for Die Castings G-6-7-00.

11.9 *Machining Stock Allowances*—Unless otherwise specified in the contract or purchase order, die cast machining stock allowances shall conform to NADCA Product Specification Standards for Die Castings standard allowances shown in S/P-4-9-00.

11.10 *Workmanship*—Die castings shall be of uniform quality, free of injurious discontinuities that will adversely affect their serviceability.

## 12. Source Inspection

12.1 If the purchaser elects to make an inspection of the casting at the producer's works, it shall be so stated in the contract or order.