



Designation: B 85 – 02

## 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. Ten alloy compositions are specified, designated as shown in Table 1.

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

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

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

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 227 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique<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 Optical Emission Spectrometric Analysis of Aluminum and 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 ANSI Standard:

H35.1 Alloy and Temper Designation Systems for Aluminum<sup>9</sup>

2.4 NADCA Product Specification Standards for Die Castings:

Standards S-4-1-94 to S-4-1-8-94, P-4-1-94 to P-4-1-7-94, S/P-4-9-94, and G-6-1-94 to G-6-7-94<sup>10</sup>

#### 2.5 Federal Standards:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)<sup>11</sup>

Fed. Std. No. 184 Identification Marking of Aluminum, Magnesium and Titanium<sup>11</sup>

#### 2.6 Military Standard:

MIL-STD-129 Marking for Shipment and Storage (Military Agencies)<sup>11</sup>

### 3. Terminology

#### 3.1 Definitions:

3.1.1 *die casting*—a metal object produced by the introduction of molten metal under substantial pressure into a metal die and characterized by a high degree of fidelity to the die cavity.

<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.

<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 American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

<sup>10</sup> Available from North American Die Casting Association (NADCA), 9701 W. Higgins Rd., Suite 880, Rosemont, IL 60018-4721.

<sup>11</sup> Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, Attn: NPODS.

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



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

Alloy <sup>D</sup>			Composition %										
ANSI	ASTM	UNS	Silicon	Iron	Copper	Manganese	Magnesium	Nickel	Zinc	Tin	Titanium	Other Constituents, Except Aluminum (Total)	Aluminum
360.0	SG100B	A03600	9.0–10.0	2.0	0.6	0.35	0.40–0.6	0.50	0.50	0.15	...	0.25	remainder
A360.0	SG100A	A13600	9.0–10.0	1.3	0.6	0.35	0.40–0.6	0.50	0.50	0.15	...	0.25	remainder
380.0	SC84B	A03800	7.5–9.5	2.0	3.0–4.0	0.50	0.10	0.50	3.0	0.35	...	0.50	remainder
A380.0 <sup>E</sup>	SC84A	A13800	7.5–9.5	1.3	3.0–4.0	0.50	0.10	0.50	3.0	0.35	...	0.50	remainder
383.0 <sup>E</sup>	SC102A	A03830	9.5–11.5	1.3	2.0–3.0	0.50	0.10	0.30	3.0	0.15	...	0.50	remainder
384.0 <sup>E</sup>	SC114A	A03840	10.5–12.0	1.3	3.0–4.5	0.50	0.10	0.50	3.0	0.35	...	0.50	remainder
390.0	SC174A	A03900	16.0–18.0	1.3	4.0–5.0	0.10	0.45–0.65	...	0.10	...	0.20	0.20	remainder
B390.0	SC174B	A23900	16.0–18.0	1.3	4.0–5.0	0.50	0.45–0.65	0.10	1.5	...	0.10	0.20	remainder
392.0	S19	A03920	18.0–20.0	1.5	0.40–0.80	0.20–0.60	0.80–1.20	0.50	0.50	0.30	0.20	0.50	remainder
413.0	S12B	A04130	11.0–13.0	2.0	1.0	0.35	0.10	0.50	0.50	0.15	...	0.25	remainder
A413.0	S12A	A14130	11.0–13.0	1.3	1.0	0.35	0.10	0.50	0.50	0.15	...	0.25	remainder
C433.0	S5C	A34430	4.5–6.0	2.0	0.6	0.35	0.10	0.50	0.50	0.15	...	0.25	remainder
518.0	G8A	A05180	0.35	1.8	0.25	0.35	7.5–8.5	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> With respect to mechanical properties, alloys A380.0, 383.0 and 384.0 are substantially interchangeable.

#### 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,

4.1.3 Part name and number,

4.1.4 Alloy (Table 1), and

4.1.5 Drawing of die casting, when required, giving all necessary dimensions and showing latest revisions and allowances for machining, if any. 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 Chemical analysis (7.1.1),

4.2.2 Quality assurance (Section 6),

4.2.3 Special proof tests or mechanical properties (Section 8),

4.2.4 General quality options for internal soundness or for finish (Section 10),

4.2.5 Source inspection (Section 11),

4.2.6 Certification (Section 12),

4.2.7 Marking for identification (Section 14), and

4.2.8 Whether the material shall be packaged, or marked, or both, in accordance with MIL-STD-129, Fed. Std. No. 123 (see 15.2), and Practices B 660 (see 15.3).

#### 5. Materials

5.1 Unless otherwise specified, only aluminum alloy conforming to the requirements of Specification B 179 or produc-

er'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. Quality Assurance

6.1 *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.

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

6.2.1 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.

6.2.2 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. Chemical Composition

7.1 *Limits*—The die castings 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.

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

7.1.2 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.

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

7.2.1 A sample shall be taken from each of two representative castings selected from each lot defined in 6.2.1.

7.3 *Methods of Sampling*—Samples from die castings for determination of chemical composition shall be taken in accordance with one of the following methods:

7.3.1 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 weight of prepared sample not less than 100 g. Sampling shall be in accordance with Practices E 88 or E 716, or both.

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

7.3.3 The method of sampling cast products for spectrochemical and other methods of analysis shall be suitable for the form of material being analyzed and the type of analytical method used.

7.4 *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 227, 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.

## 8. Mechanical Properties

8.1 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. When tension or impact tests are made, the tension test specimen shown in Fig. 18 of Test Methods E 8 and the impact test specimen shown in Fig. 6 of Test Methods E 23 shall be used.

8.2 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.

## 9. Dimensions, Mass, and Permissible Variations

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

9.1.1 Any dimensions for which a tolerance is not specified shall be in accordance with NADCA Product Specification Standards for Die Castings: Standards S-4-1-94 to S-4-1-8-94, P-4-1-94 to P-4-1-7-94, S/P-4-9-94, and G-6-1-94 to G-6-7-94.

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

## 10. General Quality

10.1 *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.

10.2 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.

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

10.4 *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 Standard G-6-6-94.

10.5 *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 Standard G-6-1-94.

## 11. Inspection

11.1 If the purchaser desires that his representative inspect or witness the inspection and testing of the product prior to shipment, such agreement shall be made by the purchaser and producer or supplier as part of the contract or purchase order.

11.2 When such inspection or witness of inspection and testing is agreed upon, the producer or supplier shall afford the purchaser's representative all reasonable facilities to satisfy him that the product meets the requirements of this specification. Inspection and tests shall be conducted so there is no unnecessary interference with the producer's operations.

## 12. Rejection and Retest

12.1 When one or more samples, depending on the approved sampling plan, fail to meet the requirements of this specification, the represented lot is subject to rejection except as otherwise provided in 12.2.

12.2 Lots rejected for failure to meet the requirements of this specification may be resubmitted for test provided:



12.2.1 The producer has removed the nonconforming material or the producer has reworked the rejected lot as necessary to correct the deficiencies.

12.3 Individual castings that show injurious imperfections during subsequent manufacturing operations may be rejected. The producer or supplier shall be responsible only for replacement of the rejected castings to the purchaser. As much of the rejected original material as possible shall be returned to the producer or supplier.

### 13. Certification

13.1 The producer or supplier shall, when called for in the contract or purchase order, furnish to the purchaser a certificate of inspection stating that each lot has been sampled, tested, and inspected in accordance with this specification, and has been found to meet the requirements specified.

### 14. Product Marking

14.1 When specified in the contract or purchase order, all castings shall be properly marked for identification with the part number, name or brand of the producer, as agreed upon. Government applications shall be marked in accordance with Fed. Std. No. 184.

### 15. Packaging and Package Marking

15.1 *Packaging*—Unless otherwise specified, the die castings shall be packaged to provide adequate protection during normal handling and transportation. Each package shall contain only one type of item unless otherwise agreed upon. The type of packaging and gross weight of containers shall, unless otherwise agreed upon, be at the producer's discretion, pro-

vided they are such as to ensure acceptance by common or other carriers for safe transportation at the lowest rate to the delivery point.

15.2 *Marking*—Each shipping container shall be legibly marked with the purchase order number, gross and net weights, and the supplier's name or trademark. Marking for shipment shall be in accordance with Fed. Std. No. 123 or Practice D 3951 for civil agencies and MIL-STD-129 for Military agencies.

15.3 *Preservation*—Material intended for prolonged storage in unheated locations shall be adequately packed and protected to avoid deterioration and damage. When specified in the contract or purchase order, material shall be preserved, packaged, and packed in accordance with the requirements of Practices B 660. The applicable levels shall be as specified in the contract or order.

### 16. Characteristics of Die Casting Alloys

16.1 Table X1.1 shows certain casting and other outstanding characteristics which are usually considered in selecting a die-casting alloy for a specific application. The characteristics are rated from (1) to (5), (1) being the best and (5) being the least desirable alloy. In applying these ratings, it should be noted that all the alloys have sufficiently good characteristics to be accepted by users and producers of die castings. Hence a rating of (5) indicates a commercial alloy, although in certain cases its application may be limited or its manufacture may be restricted to relatively simple castings.

### 17. Keywords

17.1 aluminum; die casting

## ANNEXES

<https://standards.iteh.ai/catalog/standards/sist/017985b-83ae-4dbf-a25b-970035b67d34/astm-b85-02>

### (Mandatory Information)

#### A1. BASIS FOR INCLUSION OF PROPERTY LIMITS

A1.1 Limits are established at a level at which a statistical evaluation of the data indicates that 99 % of the population obtained from all standard material meets the limit with 95 % confidence. For the products described, mechanical property limits for the respective size ranges are based on the analyses of at least 100 data from standard production material with no

more than ten data from a given lot. All tests are performed in accordance with the appropriate ASTM test methods. For informational purposes, refer to "Statistical Aspects of Mechanical Property Assurance" in the Related Material section of the *Annual Book of ASTM Standards*, Vol 02.02.

#### 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. The Aluminum Association<sup>12</sup> 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. A designation not in conflict with other designation systems or a trade name is acceptable.

<sup>12</sup> The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.