



# 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.*

## 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:<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 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
- [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
- [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)<sup>3</sup>
- [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

<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 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	0.20†	...	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.

<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 E29.

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

<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.

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

### 2.3 AMS Standard:

**AMS-STD-184 Identification Marking of Aluminum, Magnesium and Titanium<sup>4</sup>**

### 2.4 ANSI Standard:

**H35.1/H35.1(M)-2006 American National Standard Alloy and Temper Designation Systems for Aluminum<sup>5</sup>**

### 2.5 NADCA Product Specification Standards for Die Castings:<sup>6</sup>

**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)<sup>7</sup>**

### 2.7 Military Standard:

**MIL-STD-129 Marking for Shipment and Storage (Military Agencies)<sup>7</sup>**

### 2.8 Other Standards:<sup>8</sup>

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

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

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

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

<sup>7</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>8</sup> Available from European Committee for Standardization (CEN), 36 rue de Stassart, B-1050, Brussels, Belgium, <http://www.cenorm.be>.

### 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 (**16.3**),

### 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 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-1-09, 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



conform to NADCA Product Specification Standards for Die Castings G-6-2-09 and G-6-3-09.

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-6-4-09 and G-6-5-09.

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-6-5-09.

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-6-6-09.

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-6-7-09.

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-4-9-09.

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.

12.2 If the purchaser elects to have inspection made at the producer's works, the producer shall afford the inspector all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. All tests and inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

## 13. Rejection and Retest

13.1 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 13.2.

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

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

13.3 Individual castings that show injurious imperfections during subsequent manufacturing operations may be rejected. The producer or supplier shall be responsible only for replace-

ment of the rejected castings to the purchaser. As much of the rejected original material as possible shall be returned to the producer or supplier.

## 14. Certification

14.1 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.

## 15. Product Marking

15.1 Unless otherwise specified, each casting shall be marked with the applicable drawing or part number. The marking shall consist of raised Arabic numerals, and when applicable capital letters, cast integral. The location of the identification marking shall be as specified on the applicable drawing. When the location is not specified on the drawing, the drawing/part number shall be placed in a location mutually agreeable to the purchaser and producer. Government applications shall be marked in accordance with AMS-STD-184.

## 16. Packaging and Package Marking

16.1 *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, provided they are such as to ensure acceptance by common or other carriers for safe transportation.

16.2 *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 **D3951** for civil agencies and MIL-STD-129 for Military agencies.

16.3 *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 **B660**. The applicable levels shall be as specified in the contract or order.

## 17. Characteristics of Die Casting Alloys

17.1 **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 for that attribute. In considering 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 the rating for each characteristic is a relative measure of that attribute compared to the same attribute in another alloy.

## 18. Keywords

18.1 aluminum; die casting

## ANNEXES

### (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 cast aluminum or aluminum alloy shall be registered in accordance with ANSI H35.1/H35.1(M). The Aluminum Association 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/H35.1(M). A designation not in conflict with other designation systems or a trade name is acceptable.

A2.2.2 The aluminum or aluminum alloy has been offered for sale in commercial quantities within the prior twelve months to at least three identifiable users.

A2.2.3 The complete chemical composition limits are submitted.

A2.2.4 The composition is, in the judgment of the responsible subcommittee, significantly different from that of any other aluminum or aluminum alloy already in this specification.

A2.2.5 For codification purposes, an alloying element is any element intentionally added for any purpose other than grain refinement and for which minimum and maximum limits are specified. Unalloyed aluminum contains a minimum of 99.00 % aluminum.

A2.2.6 Standard limits for alloying elements and impurities are expressed to the following decimal places:

Less than 0.001 %	0.000X
0.001 to but less than 0.01 %	0.00X
0.01 to but less than 0.10 %	
Unalloyed aluminum made by a refining process	0.0XX
Alloys and unalloyed aluminum not made by a refining process	0.0X
0.10 through 0.55 %	0.XX
(It is customary to express limits of 0.30 through 0.55 % as 0.X0 or 0.X5)	
Over 0.55 %	0.X, X.X, etc.
(Except that combined Si + Fe limits for 99.00 % minimum aluminum must be expressed as 0.XX or 1.XX)	

A2.2.7 Standard limits for alloying elements and impurities are expressed in the following sequence: Silicon; Iron; Copper; Manganese; Magnesium; Chromium; Nickel; Zinc; Titanium; (Note A2.1); Other Elements, Each; Other Elements, Total; Aluminum (Note A2.2).

NOTE A2.1—Additional specified elements having limits are inserted in alphabetical order of their chemical symbols between Titanium and other Elements, Each, or are specified in footnotes.

NOTE A2.2—Aluminum is specified as *minimum* for unalloyed aluminum and as *remainder* for aluminum alloys.

**APPENDIXES**
**(Nonmandatory Information)**
**X1. CHARACTERISTICS**

X1.1 **Table X1.1** shows certain casting and other outstanding characteristics, which are usually considered in selecting a die casting alloy for a specific application.

**TABLE X1.1 Die Casting and Other Characteristics – (Inch-Pound Units) – (SI Units) – [Metric]**

NOTE 1—*Rating System*—The various alloys are rated 1 to 5 according to the positive to negative qualities in the listed categories. A rating of 1 gives the best performance, 5 the poorest performance. No one alloy is best in all categories. A rating of 5 in any one or more categories does not rule an alloy out of commercial usefulness if its other attributes are especially favorable. However, ratings of 5 may present manufacturing difficulties.

Designation			Die Casting Characteristics					Other Characteristics <sup>B</sup>					Strength at Elevated Temperatures <sup>C</sup>	
AA No. (ANSI) <sup>A</sup>	(old) ASTM <sup>A</sup>	UNS <sup>A</sup>	Approximate Melting Temperature Range, ° F [°C]	Resistance to Hot Cracking <sup>D</sup>	Pressure Tightness	Die Filling Capacity <sup>E</sup>	Anti-Soldering to the Die <sup>F</sup>	Resistance to Corrosion <sup>G</sup>	Machining <sup>H</sup>	Polishing <sup>I</sup>	Electroplating <sup>J</sup>	Anodizing (Appearance) <sup>K</sup>		Chemical Oxide Coating (Protection) <sup>L</sup>
360.0	SG100B	A03600	1035–1105 [557–596]	1	2	3	2	2	3	3	2	3	3	1
A360.0	SG100A	A13600	1035–1105 [557–596]	1	2	3	2	2	3	3	2	3	3	1
380.0	SC84B	A03800	1000–1100 [538–593]	2	2	2	1	4	3	3	1	3	4	3
A380.0	SC84A	A13800	1000–1100 [538–593]	2	2	2	1	4	3	3	1	3	4	3
383.0	SC102A	A03830	960–1080 [516–582]	1	2	1	2	3	2	3	1	3	4	2
384.0	SC114A	A03840	960–1080 [516–582]	2	2	1	2	5	3	3	2	4	5	2
390.0	SC174A	A03900	945–1200 [507–649]	4	4	1	2	3	5	5	3	5	5	3
B390.0	SC174B	A23900	950–1200 [510–649]	4	4	1	2	3	5	5	3	5	5	3
392.0	S19	A03920	1025–1245 [552–674]	4	3	1	2	2	5	5	3	5	5	3
413.0	S12B	A04130	1065–1080 [574–582]	1	1	1	1	2	4	5	3	5	3	3
A413.0	S12A	A14130	1065–1080 [574–582]	1	1	1	1	2	4	5	3	5	3	3
C443.0	S5C	A34430	1065–1170 [574–632]	3	3	4	4	2	5	4	2	2	2	5
518.0	G8A	A05180	995–1150 [535–621]	5	5	5	5	1	1	1	5	1	1	4

<sup>A</sup> 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.

<sup>B</sup> Die castings are not usually solution heat treated. Low temperature aging treatments may be used for stress relief or dimensional stability. Die castings are not generally gas or arc welded or brazed.

<sup>C</sup> Rating based on tensile and yield strengths at temperature up to 500°F (260°C), after prolonged heating at testing temperature.

<sup>D</sup> Ability of alloy to withstand stresses from contraction while cooling through hot-short or brittle temperature range.

<sup>E</sup> Ability of molten alloy to flow readily in die and fill thin sections.

<sup>F</sup> Ability of molten alloy to flow without sticking to the die surfaces. Ratings given for antisoldering are based on nominal iron compositions of approximately 1.

<sup>G</sup> Based on resistance of alloy in standard type salt spray test.

<sup>H</sup> Composite rating based on ease of cutting, chip characteristics, quality of finish and tool life.

<sup>I</sup> Composite rating based on ease and speed of polishing and quality of finish provided by typical polishing procedure.

<sup>J</sup> Ability of the alloy to take and hold an electroplate applied by present standard methods.

<sup>K</sup> Rated on lightness of color, brightness and uniformity of clear anodized coating applied in sulphuric acid electrolyte. Generally aluminum die castings are unsuitable for light color anodizing where pleasing appearance is required.

<sup>L</sup> Rated on combined resistance of coating and base alloy to corrosion.

## X2. MECHANICAL PROPERTIES

X2.1 The data in [Table X2.1](#) [[Table X2.2](#)] do not constitute a part of this specification because the data only indicates 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. Different machines and dies continue to be necessary for die castings and test bars. Comparison between static breakdown or proof tests and the mechanical properties of separately die cast test bars will show

that test bars made in a different machine in a different die have no correlation with the die casting other than a common chemical composition. It should be thoroughly understood that the data in [Table X2.1](#) [[Table X2.2](#)] represent die-cast test specimens and not specimens cut from commercial die-cast parts. For this reason, it is considered that the only practical method for mechanical property control is proof testing the whole die casting.

**TABLE X2.1 Typical Mechanical Properties Test Specimens (Inch-Pound Units)**

NOTE 1—Each value for tensile strength and yield strength shall be rounded to the nearest 0.1 ksi and each value for elongation shall be rounded to the nearest 0.5 %, both in accordance with the rounding method of Practice [E29](#).

Alloy		UNS <sup>A</sup>	Tensile Strength, ksi	Yield Strength (0.2 % Offset), ksi	Elongation in 2 in., %	Shear Strength, ksi	Fatigue Strength (R. R. Moore Specimen), 500,000,000 cycles, ksi
ANSI <sup>A</sup>	ASTM <sup>A</sup>						
360.0	SG100B	A03600	44	25	2.5	28	20
A360.0	SG100A	A13600	46	24	3.5	26	18
380.0	SC84B	A03800	46	23	2.5	28	20
A380.0	SC84A	A13800	47	23	3.5	27	20
383.0	SC102A	A03830	45	22	3.5	...	...
384.0	SC114A	A03840	48	24	2.5	29	20
390.0	SC174A	A03900	40.5	35.0	<1	...	...
B390.0	SC174B	A23900	40.5	35.0	<1	...	...
392.0	S19	A03920	42.0	39.0	<1	...	...
413.0	S12B	A04130	43	21	2.5	25	19
A413.0	S12A	A14130	42	19	3.5	25	19
C443.0	S5C	A34430	33	14	9.0	19	17
518.0	G8A	A05180	45	28	5.0	29	20

<sup>A</sup> 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](#).



**TABLE X2.2 Typical Mechanical Properties Test Specimens (SI Units) – [Metric]**

NOTE 1—Each value for tensile strength and yield strength shall be rounded to the nearest 1 MPa and each value for elongation shall be rounded to the nearest 0.5 %, both in accordance with the rounding method of Practice E29.

Alloy		UNS <sup>A</sup>	Tensile Strength, MPa <sup>B</sup>	Yield Strength (0.2 % Offset), MPa <sup>B</sup>	Elongation in In 5D mm, %	Shear Strength, MPa <sup>B</sup>	Fatigue Strength (R. R. Moore Specimen), 500,000,000 cycles MPa <sup>B</sup>
ANSI <sup>C</sup>	ASTM <sup>A</sup>						
360.0	SG100B	A03600	305	170	2.5	190	140
A360.0	SG100A	A13600	315	165	3.5	180	125
380.0	SC84B	A03800	315	160	2.5	190	140
A380.0	SC84A	A13800	325	160	3.5	185	140
383.0	SC102A	A03830	310	150	3.5	...	...
384.0	SC114A	A03840	330	165	2.5	200	140
390.0	SC174A	A03900	280	240	<1	...	...
B390.0	SC174B	A23900	280	240	<1	...	...
392.0	S19	A03920	290	270	<1	...	...
413.0	S12B	A04130	295	145	2.5	170	130
A413.0	S12A	A14130	290	130	3.5	170	130
C443.0	S5C	A34430	230	95	8.0	130	130
518.0	G8A	A05180	310	190	4.0	200	140

<sup>A</sup> 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.

<sup>B</sup> Guidelines for metric conversion from the "Tempers for Aluminum and Aluminum Alloys, Metric Edition" (Tan Sheets) Appendix A, were used to convert the tensile and yield values to SI units.

<sup>C</sup> See Appendix X3 for explanation of SI unit MPa.

### X3. METRIC EQUIVALENTS

X3.1 The SI unit for strength properties (MPa) is in accordance with the International System of Units (SI). (IEEE/ASTM SI 10). The derived SI unit for force is the newton (N), which is defined as that force which when applied to a body having a mass of one kilogram gives it an acceleration of one metre per second squared ( $N = \text{kg} \cdot \text{m}/\text{s}^2$ ). The derived SI unit

for pressure or stress is the newton per square metre ( $\text{N}/\text{m}^2$ ), which has been named the pascal (Pa) by the General Conference on Weights and Measures. Since  $1 \text{ ksi} = 6\,894\,757 \text{ Pa}$  the metric equivalents are expressed as megapascal (MPa), which is the same as  $\text{MN}/\text{m}^2$  and  $\text{N}/\text{mm}^2$ .

### SUMMARY OF CHANGES

Committee B07 has identified the location of selected changes to this standard since the last issue (B85/B85M–13) that may impact the use of this standard. (Approved Oct. 1, 2014.)

(1) Reference to Practice B985 added to subsections 2.2 and 8.2.

(2) Subsection 8.3 deleted.

(3) Subsections 8.4, 8.4.1, and 8.4.2 moved into subsection 8.1.

Committee B07 has identified the location of selected changes to this standard since the last issue (B85/B85M–10<sup>e1</sup>) that may impact the use of this standard. (Approved Oct. 15, 2013.)

(1) B390.0 properties revised in Tables X2.1 and X2.2.

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