



# 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 (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 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>

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:

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>1</sup> This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.01 on Aluminum Alloy Ingots and Castings.

Current edition approved April 10, 2003. Published August 2003. Originally approved in 1931. Last previous edition approved in 2002 as B 85 – 02.

<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 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> |                    | Aluminum  |
|--------------------------|------------|--------|-------------|------|-----------|-----------|-----------|-----|------|------|------|------|---------------------|--------------------|-----------|
| AA No. (ANSI)            | (old) ASTM | UNS    | Si          | Fe   | Cu        | Mn        | Mg        | Cr  | Ni   | Zn   | Ti   | Sn   | Each                | Total <sup>F</sup> |           |
| 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.

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 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.

### 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 D 3951 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 B 660. 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. The Aluminum Association<sup>13</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.

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 judgement 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 (Note A2.1); Titanium; 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 zinc and titanium, or are specified in footnotes.

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

<sup>13</sup> The Aluminum Association, 900 19th Street, NW, Washington, DC 20006.

## 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**

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 B 275. ANSI designations were established in accordance with ANSI H35.1. UNS designations were established in accordance with Practice E 527.

<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 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

**TABLE X2.1 Typical Mechanical Properties Test Specimens<sup>A</sup>**

| Alloy             |                   | UNS <sup>B</sup> | Tensile Strength, ksi (MPa) | Yield Strength (0.2 % Offset), ksi (MPa) | Elongation in 2 in. or 50 mm, % | Shear Strength, ksi (MPa) | Fatigue Strength (R. R. Moore Specimen), 500,000,000 cycles, ksi (MPa) |
|-------------------|-------------------|------------------|-----------------------------|--|---------------------------------|---------------------------|--|
| ANSI <sup>A</sup> | ASTM <sup>B</sup> |                  |                             |  |                                 |                           |  |
| 360.0             | SG100B            | A03600           | 44(300)                     | 25(170)                                  | 2.5                             | 28(190)                   | 20(140)  |
| A360.0            | SG100A            | A13600           | 46(320)                     | 24(170)                                  | 3.5                             | 26(180)                   | 18(120)  |
| 380.0             | SC84B             | A03800           | 46(320)                     | 23(160)                                  | 2.5                             | 28(190)                   | 20(140)  |
| A380.0            | SC84A             | A13800           | 47(320)                     | 23(160)                                  | 3.5                             | 27(190)                   | 20(140)  |
| 383.0             | SC102A            | A03830           | 45(310)                     | 22(150)                                  | 3.5                             | ...                       | ...  |
| 384.0             | SC114A            | A03840           | 48(330)                     | 24(170)                                  | 2.5                             | 29(200)                   | 20(140)  |
| 390.0             | SC174A            | A03900           | 40.5(280)                   | 35.0(240)                                | <1                              | ...                       | ...  |
| B390.0            | SC174B            | A23900           | 46.0(320)                   | 36.0(250)                                | <1                              | ...                       | ...  |
| 392.0             | S19               | A03920           | 42.0(290)                   | 39.0(270)                                | <1                              | ...                       | ...  |
| 413.0             | S12B              | A04130           | 43(300)                     | 21(140)                                  | 2.5                             | 25(170)                   | 19(130)  |
| A413.0            | S12A              | A14130           | 42(290)                     | 19(130)                                  | 3.5                             | 25(170)                   | 19(130)  |
| C443.0            | S5C               | A34430           | 33(230)                     | 14(100)                                  | 9.0                             | 19(130)                   | 17(120)  |
| 518.0             | G8A               | A05180           | 45(310)                     | 28(190)                                  | 5                               | 29(200)                   | 20(140)  |

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

<sup>B</sup> 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.

composition. It should be thoroughly understood that the data in Table X2.1 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.

### **X3. METRIC EQUIVALENTS**

X3.1 The SI unit for strength properties (MPa) is in accordance with the International System of Units (SI). 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 (B 85-99) that may impact the use of this standard. (Approved April 2003)

(1) Rewrite of the entire standard.

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