



Standard Specification for Aluminum-Alloy Die Castings¹

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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 the standard. The values given in parentheses are for information only.

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 Processes²

B 275 Practice for Codification of Certain Nonferrous Metals and Alloys, Cast and Wrought²

B 660 Practices for Packaging/Packing of Aluminum and Magnesium Products²

E 8 Test Methods for Tension Testing of Metallic Materials³

E 23 Test Methods for Notched Bar Impact Testing of Metallic Materials³

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

E 34 Test Methods for Chemical Analysis of Aluminum and Aluminum-Base Alloys⁵

E 88 Practice for Sampling Nonferrous Metals and Alloys in Cast Form for Determination of Chemical Composition⁵

E 101 Test Method for Spectrographic Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁶

E 227 Test Method for Optical Emission Spectrometric

Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique⁵

E 505 Reference Radiographs for Inspection of Aluminum and Magnesium Die Castings⁷

E 527 Practice for Numbering Metals and Alloys (UNS)⁸

E 607 Test Method for Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere⁹

E 716 Practices for Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis⁹

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 Discharge⁹

2.3 ANSI Standard:

H35.1 Alloy and Temper Designation Systems for Aluminum²

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-6-7-94²

2.5 Federal Standards:

Fed. Std. No. 123 Marking for Shipment (Civil Agencies)¹⁰

Fed. Std. No. 184 Identification Marking of Aluminum, Magnesium and Titanium¹⁰

2.6 Military Standard:

MIL-STD-129 Marking for Shipment and Storage (Military Agencies)¹⁰

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.

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

¹ This specification is under the jurisdiction of ASTM Committee B-7 on Light Metals and Alloys, and is the direct responsibility of Subcommittee B07.01 on Aluminum Alloy Ingots and Castings.

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² Annual Book of ASTM Standards, Vol 02.02.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Annual Book of ASTM Standards, Vol 03.05.

⁶ Discontinued. See 1995 Annual Book of ASTM Standards, Vol 03.05.

⁷ Annual Book of ASTM Standards, Vol 03.03.

⁸ Annual Book of ASTM Standards, Vol 01.01.

⁹ Annual Book of ASTM Standards, Vol 03.06.

¹⁰ Available from Standardization Documents Order Desk, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5094, Attn: NPODS.

TABLE 1 Chemical Requirements^{A,B,C}

Alloy ^D			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 ^E	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 ^E	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 ^E	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

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

^B For purposes of acceptance and rejection, the observed value or calculated value obtained from analysis should be rounded off to the nearest unit in the last right-hand place of figures, used in expressing the specified limit, in accordance with the rounding procedure prescribed in Section 3 of Practice E 29.

^C Limits are in percent maximum unless shown otherwise.

^D Alloys 360.0, 380.0, 413.0, C443.0 and 518.0 are suitable for the production of die casting by either the hot-chamber or the cold-chamber process. Die castings of alloys A360.0, A380.0, 383.0, 384.0 and A413.0 may be made only in cold-chamber machines.

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

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

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 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. 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 101, 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 ADCI Product Standard E 18.

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 ADCI Product Standard E 17.

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.

12.2.3 Individual castings that show injurious imperfections during subsequent manufacturing operations may be rejected.