



Standard Specification for Magnesium-Alloy Permanent Mold Castings¹

This standard is issued under the fixed designation B199; 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 magnesium alloy permanent mold casting alloys designated as shown in **Table 1**.

1.2 The values stated in inch-pound units are to be regarded as the standard. The SI values given in parentheses are provided for information only.

1.3 *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 limitations 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*:²

- B296** Practice for Temper Designations of Magnesium Alloys, Cast and Wrought
- B557** Test Methods for Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
- B660** Practices for Packaging/Packing of Aluminum and Magnesium Products
- B661** Practice for Heat Treatment of Magnesium Alloys
- B951** Practice for Codification of Unalloyed Magnesium and Magnesium-Alloys, Cast and Wrought
- B953** Practice for Sampling Magnesium and Magnesium Alloys for Spectrochemical Analysis
- B954** Test Method for Analysis of Magnesium and Magnesium Alloys by Atomic Emission Spectrometry
- E8** Test Methods for Tension Testing of Metallic Materials
- E29** Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications
- E88** Practice for Sampling Nonferrous Metals and Alloys in Cast Form for Determination of Chemical Composition
- E94** Guide for Radiographic Examination
- E155** Reference Radiographs for Inspection of Aluminum and Magnesium Castings
- E165** Practice for Liquid Penetrant Examination for General Industry
- E527** Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

¹ This specification is under the jurisdiction of ASTM Committee B07 on Light Metals and Alloys and is the direct responsibility of Subcommittee B07.04 on Magnesium Alloy Cast and Wrought Products.

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² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

- Fed. Std. No. 123** Marking for Shipment (Civil Agencies)³
- 2.4** *Aerospace Materials Specification*:⁴
- AMS 2768** Heat Treatment of Magnesium Alloy Castings

3. Terminology

3.1 *Definitions*:

3.1.1 *permanent mold casting*—a metal object produced by introducing molten metal by gravity or low pressure into a mold constructed of durable material, usually iron or steel, and allowing it to solidify.

3.1.2 *semipermanent mold casting*—a permanent mold casting which is made using an expendable core such as bonded sand.

4. Ordering Information

4.1 Orders for castings under this specification shall include the following information:

- 4.1.1 Quantity of each casting,
- 4.1.2 Alloy (Section 7 and **Table 1**),
- 4.1.3 Temper (Section 8 and **Table 2**),
- 4.1.4 Minimum properties of specimens cut from castings, if required (see section 9.3),
- 4.1.5 Drawing showing dimensions of the castings (the amount of stock left for machine finish should be indicated),
- 4.1.6 Surface treatment (see **10.1**),

³ Available from Standardization Documents Order Desk, DODSSP, Bldg. 4, Section D, 700 Robbins Ave., Philadelphia, PA 19111-5098, <http://www.dodssp.daps.mil>.

⁴ Available from SAE International (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

TABLE 1 Chemical Composition Limits^A

NOTE 1—Analysis shall regularly be made only for the elements specifically mentioned in this table. If, however, the presence of other elements is suspected or indicated in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in excess of the specified limits.

NOTE 2—The following applies to all specified limits in this table: For purposes of acceptance and rejection, an observed value or a calculated value obtained from analysis shall be rounded to the nearest unit in the last right-hand place of figures used in expressing the specified limit.

Alloy Number ^B		Composition, %											
ASTM	UNS	Iron	Magnesium	Aluminum	Manga- nese	Zinc	Rare Earths	Zirconium	Silicon	Copper	Nickel	Total ^C Other Impuri- ties	Others Each
AM100A	M10100	...	remainder	9.3 to 10.7	0.10–0.35	0.30	...	...	0.30	0.10	0.01	0.30	...
AZ81A	M11810	...	remainder	7.0 to 8.1	0.13–0.35	0.40 to 1.0	...	...	0.30	0.10	0.01	0.30	...
AZ91C	M11914	...	remainder	8.1 to 9.3	0.13–0.35	0.40 to 1.0	...	...	0.30	0.10	0.01	0.30	...
AZ91E	M11919	0.005 ^D	remainder	8.1 to 9.3	0.17–0.35	0.40 to 1.0	...	...	0.20	0.015	0.0010	0.30	0.01
AZ92A	M11920	...	remainder	8.3 to 9.7	0.10–0.35	1.6 to 2.4	...	...	0.30	0.25	0.01	0.30	...
EQ21A ^E	M18330	...	remainder	...	...	...	1.5 to 3.0 ^F	0.40 to 1.0	...	0.05–0.10	0.01	0.30	...
EZ33A	M12330	...	remainder	...	...	2.0 to 3.1	2.5 to 4.0	0.50 to 1.0	...	0.10	0.01	0.30	...
QE22A ^G	M18220 ^E	...	remainder	...	...	...	1.8 to 2.5 ^F	0.40 to 1.0	...	0.10	0.01	0.30	...

^A Limits are in weight percent max unless shown as a range or stated otherwise.

^B ASTM alloy designations were established in accordance with Practice B951. UNS designations were established in accordance with Practice E527.

^C Includes listed elements for which no specific limit is shown.

^D If iron exceeds 0.005 %, the iron to manganese ratio shall not exceed 0.032.

^E Silver content for Alloy EQ21A (M18330) shall be 1.3 to 1.7 %.

^F Rare earth elements are in the form of didymium.

^G Silver content for Alloy QE22A (M18220) shall be 2.0 to 3.0, inclusive.

TABLE 2 Tensile Requirements

NOTE 1—For purposes of determining conformance with this specification, 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 Number		Temper ^A	Tensile Strength, min. ksi (MPa)	Yield Strength ^B (0.2 % offset) min. ksi (MPa)	Elongation in 2 in., (50.8 mm) min., %
ASTM	UNS				
AM100A	M10100	F	20.0 (138)	10.0 (69)	^C
		T4	34.0 (234)	10.0 (69)	6
		T6	34.0 (234)	15.0 (103)	2
		T61	34.0 (234)	17.0 (117)	^C
AZ81A	M11810	T4	34.0 (234)	11.0 (76)	7
AZ91C	M11914	F	23.0 (158)	11.0 (76)	^C
		T4	34.0 (234)	11.0 (76)	7
AZ91E	M11919	T5	23.0 (158)	12.0 (83)	2
		T6	34.0 (234)	16.0 (110)	3
		T6	34.0 (234)	16.0 (110)	...
		F	23.0 (158)	11.0 (76)	^C
AZ92A	M11920	T4	34.0 (234)	11.0 (76)	6
		T5	23.0 (158)	12.0 (83)	^C
		T6	34.0 (234)	18.0 (124)	^C
		T6	34.0 (234)	25.0 (172)	...
EQ21A	M18330	T6	34.0 (234)	25.0 (172)	...
EZ33A	M12330	T5	20.0 (138)	14.0 (96)	2
QE22A	M18220	T6	35.0 (241)	25.0 (172)	2

^A These temper designations were established in accordance with Practice B296.

^B See X1.3.

^C Not required.

4.1.7 Whether inspection is required at the manufacturer's works (see section 11.1.1),

4.1.8 Special inspection requirements (see 11.2),

4.1.9 Whether certification is required (see 13.1), and

4.1.10 Whether marking for identification is required (see 14.1).

5. Manufacture

5.1 The responsibility of furnishing castings that can be laid out and machined to the finished dimensions within the permissible variations specified, as shown on the blueprints or drawings, shall rest with the supplier, except when molds are furnished by the purchaser. Sufficient stock shall be allowed for