Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 4455B
Superseding AMS 4455A

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MAGNESIUM ALLOY CASTINGS, INVESTMENT
10Al (AM100A-T6)

1. SCOPE:

1.1 Form: This specification covers a magnesium-base alloy in the form of investment castings.

1.2 Application: Primarily for small intricate parts, which may operate at temperatures up to 300 F (149 C) and are cast to approximately final dimensions, where the intricacy of the part is such that high fluidity of the molten metal is required.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Materials Specifications:

AMS 2350 - Standards and Test Methods
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E35 - Chemical Analysis of Magnesium and Magnesium-Base Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E35, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods.

	min	max
Aluminum	9.3	10.7
Manganese	0.10	--
Zinc	--	0.30
Silicon	--	0.30
Copper	--	0.10
Nickel	--	0.01
Other Impurities, Total	--	0.30
Magnesium	remainder	

3.2 Condition: Solution and precipitation heat treated.

3.3 Casting: Castings shall be poured either from remelted metal from a master heat or master heat lot or directly from a master heat. In either case, metal for casting shall be qualified as in 3.4. A master heat is refined metal of a single furnace charge. Gates, sprues, risers, and rejected castings shall be used only in preparation of master heats; they shall not be remelted directly, without refining, for pouring of castings. Furnace or ladle additions of grain refining elements are permissible. If grain refining elements are not added, the molten metal shall be subjected to superheating or other grain refining treatment.

3.3.1 Unless prohibited by purchaser, metal from two or more master heats may be blended to form a master heat lot provided that the composition of each master heat to be blended is within the limits of 3.1 and that the total weight of metal in the master heat lot does not exceed 600 lb (272 kg). Ingot and pig may be blended, shot may be blended, but shot shall not be blended with ingot or pig.

3.4 Master Heat Qualification: Each master heat and master heat lot shall be qualified by evaluation of chemical analysis and tensile test specimens conforming to 3.4.1 and 3.4.2, respectively. A master heat or master heat lot may be considered conditionally qualified if vendor's test results show conformance to all applicable requirements of this specification. However, except when purchaser waives confirmatory testing, final qualification shall be based on purchaser's test results. Conditional qualification of a master heat lot shall not be construed as a guarantee of acceptance of castings poured therefrom.

3.4.1 Chemical Analysis Specimens: Shall be of any convenient size, shape, and form for vendor's tests. When chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and vendor. Composition of specimens shall conform to 3.1.

3.4.2 Tensile Test Specimens: Shall be cast from remelted metal from each master heat or master heat lot except that when castings are poured directly from a master heat, the tensile test specimens shall also be poured directly from the master heat. Tensile test specimens shall be of standard proportions with 0.25 in. (6.4 mm) diameter at the reduced parallel gage section in accordance with ASTM E8. They shall be cast to size or shall be cast oversize and subsequently machined to 0.25 in. (6.4 mm) diameter. Center gating may be used. When requested, representative test specimens shall be supplied to the purchaser for confirmatory evaluation. Tensile test specimens shall conform to the requirements of 3.6.1.

3.5 Heat Treatment: All castings and tensile test specimens shall be heat treated as follows:

3.5.1 Tensile test specimens from each master heat or master heat lot and production castings shall be heated to the proper temperature and for the proper time for solution heat treatment and cooled in air. At least one set of tensile test specimens shall be put into a batch-type furnace with each load of castings or into a continuous furnace at intervals of not longer than 3 hours.

3.5.2 Tensile test specimens from each master heat or master heat lot and production castings shall, after solution heat treatment as in 3.5.1, be heated to the proper temperature and for the proper time for precipitation heat treatment. At least one set of tensile test specimens shall be put into a batch-type furnace with each load of castings or into a continuous furnace at intervals of not longer than 3 hours.

3.6 Properties:

3.6.1 Properties of Separately Cast Test Specimens: Test specimens produced in accordance with 3.4.2 and heat treated as in 3.5 shall conform to the following requirements, determined in accordance with ASTM E8:

Tensile Strength, min	34,000 psi (234 MPa)
Yield Strength at 0.2% Offset, min	20,000 psi (138 MPa)
Elongation in 1 in. (25.4 mm) or 4D, min	2%

3.6.2 Properties of Castings:

3.6.2.1 Hardness: Castings, except at sprues and risers, shall have hardness of 70 - 95 HRE or equivalent, determined in accordance with ASTM E18.

3.6.2.2 Tensile Properties: When tensile properties of actual castings are required, not less than 4, and preferably 10, tensile test specimens shall be cut from thick and thin sections. The average value of all specimens selected shall conform to the following, determined in accordance with ASTM E8:

Tensile Strength, min	25,500 psi (176 MPa)
Yield Strength at 0.2% Offset, min	11,500 psi (79 MPa)
Elongation in 1 in. (25.4 mm) or 4D, min	1%

3.6.2.2.1 Any specimen cut from a casting shall conform to the following:

Tensile Strength, min	17,000 psi (117 MPa)
Yield Strength at 0.2% Offset, min	9,500 psi (66 MPa)

3.7 Quality:

3.7.1 Castings shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts. Castings shall have smooth surfaces and shall be well cleaned.

3.7.2 Unless otherwise specified, castings shall be produced under radiographic control. This shall consist of radiographic examination of castings in accordance with AMS 2635 until proper foundry technique, which will produce castings free from harmful internal imperfections, is established for each part number and of production castings as necessary to ensure maintenance of satisfactory quality.

3.7.3 When specified, castings shall be subject to fluorescent penetrant inspection in accordance with AMS 2645.

3.7.4 Radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor.

3.7.5 Castings shall not be repaired by plugging, welding, or other methods without written permission from purchaser.

3.7.6 Castings shall not be impregnated, chemically treated, or coated to prevent leaking, unless specified or allowed by written permission which states the method to be used.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that castings conform to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.

4.3 Sampling: Shall be in accordance with the following, unless otherwise specified:

4.3.1 Two chemical analysis specimens in accordance with 3.4.1 or a casting from each master heat or master heat lot.

4.3.2 Three tensile test specimens in accordance with 3.4.2 from each master heat or master heat lot.

4.3.3 Two preproduction castings of each part number.

4.3.4 When properties are required from specimens machined from castings, a casting shall be selected at random from each master heat or master heat lot.

4.4 Approval:

4.4.1 Sample castings from new or reworked master patterns and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived.

4.4.2 Vendor shall establish separately for tensile test specimens used for master heat qualification and for production of sample castings of each part number, the control factors of processing which will produce tensile test specimens meeting master heat qualification requirements and acceptable castings; these shall constitute the approved casting procedures and shall be used for producing subsequent master heat qualification specimens and production castings. If necessary to make any change in control factors of processing which could affect quality or properties of the castings, vendor shall submit for reapproval a statement of the revised operations and, when requested, sample test specimens, castings, or both. No production castings incorporating the revised operations shall be shipped prior to receipt of reapproval.

4.4.2.1 Control factors for producing test specimens and castings include, but are not limited to, the following:

Type of furnace and its capacity
Size of furnace charge
Furnace atmosphere
Fluxing or deoxidation procedure
Mold refractory formulation
Mold backup material
Gating practices
Mold pre-heating temperature, pouring temperature, or both (variation of ± 25 F (± 14 C) is permissible)
Solidification rate and subsequent cooling procedures
Cleaning operations
Solution and precipitation heat treatment cycles
Method of routine inspection

4.4.2.2 Any of the above control factors of processing considered proprietary by the vendor may be assigned a code designation. Each variation in such factors shall be assigned a modified code designation.