



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 4229A

Superseding AMS 4229

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ALUMINUM ALLOY CASTINGS, HIGH STRENGTH
4.5 Cu - 0.70Ag - 0.30Mn - 0.25Mg - 0.25Ti (201.0-T7)
Solution Heat Treated and Overaged

1. SCOPE:

- 1.1 Form: This specification covers an aluminum alloy in the form of high strength sand, permanent mold, and composite mold castings.
- 1.2 Application: Primarily for components where a combination of high strength and moderate ductility with optimum resistance to stress-corrosion cracking is desired.

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., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2360 - Room Temperature Tensile Properties of Castings
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2646 - Contrast Dye Penetrant Inspection
AMS 2804 - Identification, Castings

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

ASTM B117 - Salt Spray (Fog) Testing
ASTM B557 - Tension Testing Wrought and Cast Aluminum and Magnesium Alloy Products
ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E34 - Chemical Analysis of Aluminum and Aluminum-Base Alloys

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

2.3.1 Federal Standards:

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

2.3.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products; Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against infringement of patents."

- 3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E34, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Copper	4.0	5.0
Silver	0.40	1.0
Manganese	0.20	0.40
Magnesium	0.15	0.35
Titanium	0.15	0.35
Iron	--	0.10
Silicon	--	0.05
Other Impurities, each	--	0.03
Other Impurities, total	--	0.10
Aluminum	remainder	

- 3.2 Condition: Solution heat treated and overaged.

- 3.3 Casting: Castings shall be produced in lots from metal conforming to 3.1. Metal remelted from previously analyzed ingot may be poured directly into castings. Furnace or ladle additions of grain refining elements or alloys are permissible. Unless otherwise agreed upon by purchaser and vendor, molten metal taken from alloying furnaces, with or without additions of foundry operating scrap (gates, sprues, risers, and rejected castings), shall not be poured into castings unless first converted to ingot, analyzed, and remelted or unless the composition of a sample taken after the last addition to the melt has been found to conform to 3.1. The type of mold used for castings is not restricted.

- 3.3.1 A melt shall be the metal withdrawn from a batch-furnace charge of 2000 lb (908 kg) or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 lb (1816 kg) or less of metal withdrawn from one continuous furnace in not more than 8 consecutive hours.

- 3.3.2 A lot shall consist of castings poured from a single melt in not more than 8 consecutive hours.

- 3.4 Cast Test Specimens: When tensile test specimens and chemical analysis specimens are required, they shall be cast as follows and, when requested, shall be supplied with the castings:

- 3.4.1 Tensile Test Specimens: Shall be cast with each lot of castings, shall be of standard proportions conforming to ASTM B557 with 0.500 in. (12.70 mm) diameter at the reduced parallel gage section, and shall be cast to size in molds representative of the practice used for castings. Metal for the specimens shall be part of the melt which is used for the castings. If the metal for castings is given any treatment, such as fluxing or cooling and reheating, the metal for the specimens shall be a portion of the metal so treated and, during such treatment, shall be heated to the same maximum temperature and held for approximately the same length of time as the molten metal for the castings. The temperature of the metal during pouring of the specimens shall be not lower than that during pouring of the castings.

- 3.4.2 Chemical Analysis Specimens: Shall be cast from each melt and shall be of the size and shape agreed upon by purchaser and vendor.

3.5 Heat Treatment: All castings and representative tensile test specimens shall be solution heat treated and overaged in such a manner as to ensure conformance to the requirements of 3.6. The overaging heat treatment shall include a time of not less than 4 hr at $370^{\circ}\text{F} \pm 10$ ($187.8^{\circ}\text{C} \pm 5.6$). At least one set of tensile test specimens shall, during each stage of heat treatment, 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: Castings and representative test specimens shall conform to the following requirements:

3.6.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B557; conformance to the requirements of 3.6.1.1 shall be used as basis for acceptance of castings, except when 3.6.1.2 applies:

Ø 3.6.1.1 Specimens Cut From Castings:

3.6.1.1.1 Designated Casting Areas:

Tensile Strength, min	60,000 psi (414 MPa)
Yield Strength at 0.2% Offset, min	50,000 psi (345 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	3%

3.6.1.1.2 Other Casting Areas:

Tensile Strength, min	56,000 psi (386 MPa)
Yield Strength at 0.2% Offset, min	48,000 psi (331 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	1.5%

3.6.1.1.3 When properties other than those of 3.6.1.1.1 and 3.6.1.1.2 are specified, tensile test specimens cut, at locations indicated on the drawing, from a casting chosen at random to represent the lot, shall have the properties indicated on the drawing for each specimen. Property requirements may be designated in accordance with AMS 2360.

3.6.1.2 Separately Cast Test Specimens: The following requirements apply only when separately cast specimens are required:

Tensile Strength, min	60,000 psi (414 MPa)
Yield Strength at 0.2% Offset, min	50,000 psi (345 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	3%

3.6.2 Hardness of Castings: Except at sprue and riser locations, castings should have hardness not lower than 110 HB/10/500, 110 HB/14.3/1000, or 115 HB/10/1000, determined in accordance with ASTM E10, but shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.1 are met.

3.6.3 A tensile test specimen, cut from a designated area of a casting shall show no evidence of stress-corrosion cracking when stressed to 75% of the specified minimum yield strength and held at constant strain. The stressed specimen shall be subjected to cyclic immersion at room temperature for 30 days in a 3-1/2% solution of sodium chloride conforming to the purity and pH requirements of ASTM B117; each cycle shall consist of 10 min. immersion and 50 min. out of solution. Specimens shall be dry prior to each immersion.

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 Castings shall be produced under radiographic control, unless otherwise specified. This control 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 or to contrast dye penetrant inspection in accordance with AMS 2646.
- 3.7.4 Radiographic, fluorescent penetrant, contrast dye penetrant, and other quality standards shall be as agreed upon by purchaser and vendor.
- 3.7.5 Castings shall not be repaired by plugging, peening, welding, or other methods without written permission from purchaser.
- 3.7.5.1 When permitted in writing by purchaser, defects in castings may be removed and the castings repaired by welding provided the weld repair area has properties comparable to those of the parent metal. Repair welds shall be subjected to the same inspection procedures and acceptance standards required of the casting, and the weld repair area shall be suitably marked to facilitate inspection. The repair welding shall be performed prior to any heat treatment and nondestructive testing specified herein.
- 3.7.6 Castings shall not be impregnated, chemically treated, or coated to prevent leaking unless specified or allowed by written permission of purchaser which states the method to be used.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of castings 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 ensure that the castings conform to the requirements of this specification.
- 4.2 Classification of Tests:
- 4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), tensile property (3.6.1), and hardness (3.6.2) requirements are classified as acceptance or routine control tests.
- 4.2.2 Qualification Tests: Tests to determine conformance to stress-corrosion (3.6.3) requirements are classified as qualification or periodic control tests.
- 4.2.2.1 For direct U.S. Military procurement, qualification test material and supporting test data shall be submitted to the cognizant qualification agency as directed by the request for procurement, the procuring activity, or the contracting officer.
- 4.3 Sampling: Shall be as follows:
- 4.3.1 Two chemical analysis specimens in accordance with 3.4.2 or a casting from each lot.