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

AEROSPACE MATERIAL SPECIFICATION

AMS 4223

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Revised

ALUMINUM ALLOY CASTINGS
4.5Cu - 0.70Ag - 0.30Mn - 0.25Mg - 0.25Ti (A201.0-T4)
Solution Heat Treated and Naturally Aged

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of sand, permanent mold, and composite mold castings.

1.2 Application: Primarily for components requiring high strength. Useful where upgrading of properties of AMS 4230 or AMS 4240 is required. Artificial aging may cause this material to be susceptible to stress-corrosion cracking. Casting, machining, finishing, and assembly operations should be designed to minimize assembly and/or residual stresses.

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, Pennsylvania 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, Pennsylvania 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, 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 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 naturally aged.

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 other 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 the 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 time as the molten metal for 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 tensile test specimens representing them shall be solution heat treated and naturally aged as follows; at least one set of tensile test specimens shall, during solution 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 three hours.

3.5.1 The solution heat treatment shall consist of heating to 980° F ± 10 (526.7° C ± 5.6), holding at heat for 8 - 24 hr, and quenching immediately in water at 75° - 140° F (23.9° - 60° C).

3.5.2 The natural aging shall consist of five days at room temperature.

3.6 Properties:

3.6.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B557:

3.6.1.1 Specimens Cut From Castings:

3.6.1.1.1 Designated Casting Areas: Test specimens cut from designated areas of castings shall conform to the following requirements:

Tensile Strength, min	50,000 psi (345 MPa)
Yield Strength at 0.2% Offset, min	30,000 psi (207 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	12%

3.6.1.1.2 Other Casting Areas: Test specimens cut from any area of a casting, other than designated areas, shall conform to the following requirements:

Tensile Strength, min	35,000 psi (241 MPa)
Yield Strength at 0.2% Offset, min	25,000 psi (172 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	5%

3.6.1.1.3 Conformance to the requirements of 3.6.1.1.1 and 3.6.1.1.2 shall be used as basis for acceptance of castings.

3.6.1.1.4 When properties other than those of 3.6.1.1.1 and 3.6.1.1.2 are specified, tensile 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. The required properties 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	50,000 psi (345 MPa)
Yield Strength at 0.2% Offset, min	30,000 psi (207 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	12%

3.6.1.3 Hardness of Casting: Except at sprue and riser locations, castings should have hardness not lower than 80 HB/10/500/30, 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.

3.6.2 Stress-Corrosion Cracking Test: A tensile specimen cut from a designated area of a casting shall be capable of showing 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 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 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.

3.7.6 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 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 assure that 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 properties of specimens cut from castings (3.6.1.1) and/or, when required, tensile properties of separately-cast specimens (3.6.1.2), and hardness requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests to determine conformance to stress-corrosion test (3.6.2) requirements are classified as qualification or periodic control tests.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Acceptance Tests:

4.3.1.1 Two chemical analysis specimens in accordance with 3.4.2 or a casting from each lot.

4.3.1.2 Two preproduction castings in accordance with 4.4.1 of each part number.

4.3.1.3 Three tensile test specimens in accordance with 3.4.1 from each lot, when requested.

4.3.1.4 When properties are required from specimens machined from castings, one casting from each lot. Specimens shall conform to ASTM B557 and shall be either 0.500 in. (12.70 mm) diameter at the reduced parallel gage section or subsize specimens proportional to the standard or shall be standard sheet-type specimens. If specimen locations are not shown on the drawing, not less than two tensile specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting from each lot.

4.3.2 Qualification Tests: One specimen from a casting representative of the first production lot and, unless otherwise specified, one specimen from a casting each subsequent month representing castings produced during that month.

4.4 Approval:

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

4.4.2 Vendor shall establish for production of sample castings of each part number the control factors of processing which will produce acceptable castings; this shall constitute the approved casting procedure and shall be used for 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 detailed statement of the revised operations and, when requested, sample castings. No production castings incorporating the revised operations shall be shipped prior to receipt of reapproval.