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

AEROSPACE MATERIAL SPECIFICATION

AMS 4224A
Superseding AMS 4224

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ALUMINUM ALLOY CASTINGS, SAND
4.0Cu - 2.1Ni - 2.0Mg - 0.30Cr - 0.30Mn - 0.13Ti - 0.13V (243.0)
Stabilized

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of sand castings.

1.2 Application: Primarily for components operating up to 600°F (315°C).

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 B557 - Tension Testing Wrought- and Cast-Aluminum- and Magnesium-Alloy Products
ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E34 - Chemical Analysis of Aluminum and Aluminum Alloys
ASTM E155 - Reference Radiographs for Inspection of Aluminum and Magnesium Castings, Series III

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:

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:

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	min	max
Copper	3.5	4.5
Nickel	1.9	2.3
Magnesium	1.8	2.3
Chromium	0.20	0.40
Manganese	0.15	0.45
Titanium	0.06	0.20
Vanadium	0.06	0.20
Iron	--	0.40
Silicon	--	0.35
Zinc	--	0.05
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Stabilization heat treated.

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.

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 be all castings poured from a single melt in not more than 8 consecutive hours.

3.3.3 During melting, the metal shall be heated to not higher than 1500°F (815°C). The temperature of metal being poured into the mold shall not exceed 1375°F (745°C).

3.4 Cast Test Specimens: Chemical analysis specimens and tensile test specimens shall be cast as follows and, when requested, shall be supplied with the castings:

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

3.4.2 Tensile Test Specimens: Shall be cast with each lot of castings, shall be of standard proportions conforming to ASTM B557 with 0.500 in (12.50 mm) diameter at the reduced parallel gage section, and shall be cast to size in molds made with the regular foundry mix of sand, without using chills. 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. The temperature of the metal during pouring of the specimens shall be not lower than that during pouring of the castings.

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3.5 Heat Treatment: Castings and representative tensile test specimens shall be stabilization heat treated by heating uniformly to 600°F ± 10 (315°C ± 5) holding at heat for not less than 5 hr, and cooling in air; at least one set of 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: Castings and representative tensile test specimens produced in accordance with 3.4.2 shall conform to the following requirements:

3.6.1 Tensile Properties:

3.6.1.1 At Room Temperature: Shall be as follows, determined in accordance with ASTM B557; conformance to the requirements of 3.6.1.1.1 shall be used as basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.1.1.2 apply:

3.6.1.1.1 Separately-Cast Specimens:

Tensile Strength, min	24,000 psi (165 MPa)
Elongation in 4D, min	1.0%

3.6.1.1.2 Specimens Cut From Castings:

3.6.1.1.2.1 When tensile properties of actual castings are determined for acceptance, the average of not less than 4, and preferably 10, specimens cut from thick and thin sections shall be as follows:

Tensile Strength, min	18,000 psi (124 MPa)
Elongation in 4D, min	0.5%

3.6.1.1.2.2 When properties other than those of 3.6.1.1.2.1 are required, tensile test specimens as in 4.3.4 taken from locations indicated on the drawing, from a casting chosen at random to represent the lot, shall have the properties indicated on the drawing for such specimens. Property requirements may be designated in accordance with AMS 2360.

3.6.1.2 At 600°F (316°C): Shall be as follows, determined in accordance with ASTM E21 on separately-cast specimens heated to 600°F ± 5 (316°C ± 3), held at heat for 10 min. before testing, and tested at 600°F ± 5 (316°C ± 3) at a rate not greater than 0.05 in. per in. per min. (0.05 (mm/mm)/min.) up to the yield strength and at a rate of 0.11 - 0.14 in. per in. per min. (0.11 - 0.14 (mm/mm)/min.) above the yield strength:

Tensile Strength, min	14,000 psi (97 MPa)
Elongation in 4D, min	4.0%

3.6.2 Hardness of Castings: Castings, except at sprue and riser locations, should have hardness not lower than 70 HB/10/500, 70 HB/14.3/1000, or 75 HB/10/1000, determined in accordance with ASTM E10, but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.1.2 are met.

3.7 Quality:

3.7.1 Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the castings.

3.7.1.1 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 Ø 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 subjected to fluorescent penetrant inspection in accordance with Ø 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 Ø as agreed upon by purchaser and vendor. ASTM E155 may be used to define radiographic acceptance standards.

3.7.5 Castings shall not be repaired by peening, plugging, welding, or other methods without written Ø 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 Ø parent metal. Repair welds shall be subjected to the same inspection procedures and acceptance standards required of the castings. Weld repair areas shall be suitably marked to facilitate inspection. 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 leakage, unless specified or allowed by written permission of purchaser, designating 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 Ø 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 requirements for composition (3.1), room-temperature tensile properties (3.6.1.1.1 or 3.6.1.1.2), hardness (3.6.2) and quality (3.7) are Ø classified as acceptance tests and shall be performed to represent each lot.

4.2.1.1 Tensile properties of specimens cut from castings shall be determined only when specified by purchaser or when separately-cast specimens are not available. Tensile properties of separately-Ø cast specimens need not be determined when tensile properties of specimens cut from castings are determined.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for elevated-temperature tensile Ø properties (3.6.1.2) are classifed as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on the first-article shipment Ø of a casting to a purchaser, when a change in material or processing requires reapproval, or when purchaser deems confirmatory testing is required.

4.2.3.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduc-Ø tion test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.