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

AEROSPACE MATERIAL SPECIFICATION

AMS 4219A
Superseding AMS 4219
Issued 3-15-66
Revised 10-16-78

ALUMINUM ALLOY CASTINGS, PREMIUM GRADE
7.0Si - 0.58 Mg
Solution and Precipitation Heat Treated

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 parts, such as hydraulic pump components, requiring high strength.

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 2770 - Heat Treatment of Aluminum and Aluminum Alloys
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 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:

	min	max
Silicon	6.5	7.5
Magnesium	0.45	0.7
Titanium	0.10	0.20
Beryllium	0.04	0.07
ø Iron	--	0.20
Copper	--	0.20
Manganese	--	0.10
Zinc	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution and precipitation 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.

3.4 Cast Test Specimens: Chemical analysis specimens, and tensile test specimens when required, ø 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. (12.70 mm) diameter at the reduced parallel gage section, and shall be cast to size in molds representative of the practice used for castings. Metal ø 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.

3.5 Heat Treatment: Castings and representative tensile test specimens shall be solution and precipitation heat treated in accordance with AMS 2770; at least one set of 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 tensile test specimens produced in accordance with 3.4.2 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 purchaser specifies that 3.6.1.2 applies:

3.6.1.1 Specimens Cut From Castings:

3.6.1.1.1 Test specimens cut from any area of the castings shall conform to the following requirements:

Tensile Strength, min	38,000 psi (262 MPa)
Yield Strength at 0.2% Offset, min	30,000 psi (207 MPa)
Elongation in 4D, min	2.0%

3.6.1.1.2 When properties other than those of 3.6.1.1.1 are required, tensile test specimens taken in 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 Separately-Cast Specimens: The following requirements apply only when separately-cast specimens are required:

Tensile Strength, min	45,000 psi (310 MPa)
Yield Strength at 0.2% Offset, min	36,000 psi (248 MPa)
Elongation in 4D, min	3.0%

3.6.2 Hardness of Castings: Castings, except at sprue and riser locations, should have hardness of 80 - 115 HB/10/500, 80 - 115 HB/14.3/1000, or 85 - 120 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 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 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 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. ASTM E155 may be used to define radiographic acceptance standards.

3.7.5 Ø Castings shall not be repaired by peening, plugging, 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 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), tensile properties of specimens cut from castings (3.6.1.1) or, when specified, of separately-Ø cast specimens (3.6.1.2), and quality (3.7) are classified as acceptance tests and shall be performed on each lot of castings.

4.2.2 Periodic Tests: Tests to determine conformance to hardness (3.6.2) requirements are classified Ø 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 Ø shipment of castings 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, preproduction test material shall be submitted to the cognizant agency as directed by the procuring Ø activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Two chemical analysis specimens in accordance with 3.4.1 from each melt and/or a casting Ø from each lot.

4.3.2 At least two tensile test specimens machined from castings from each lot except when purchaser specifies use of separately-cast specimens. Specimens shall conform to ASTM B557 and shall be either 0.500 in. (12.70mm) diameter at the reduced parallel gage section, subsize specimens Ø proportional to the standard, or standard sheet-type specimens. If specimen locations are not shown on the drawing, not less than two specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting or castings.

Ø 4.3.3 Two preproduction castings in accordance with 4.4.1 of each part number.

Ø 4.3.4 Three tensile test specimens in accordance with 3.4.2 from each lot, when requested.