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400 COMMONWEALTH DRIVE WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4228A

Issued 11-1-69
Revised 10-1-82

UNS A02010

ALUMINUM ALLOY CASTINGS, HIGH STRENGTH
4.5Cu - 0.70Ag - 0.30Mn - 0.25Mg - 0.25Ti (201.0-T6)
Solution and Precipitation Heat Treated

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of 10-1-82. It is recommended that this specification not be specified for new designs.

This cover sheet should be attached to the "A" revision of the subject specification.

This specification was declared "NONCURRENT" for the reason that subject castings are subject to stress-corrosion cracking and also offer no significant benefits over AMS 4229, ALUMINUM ALLOY CASTINGS, HIGH STRENGTH, 4.5Cu - 0.70Ag - 0.30Mn - 0.25Mg - 0.25Ti (201.0-T7), Solution Heat Treated and Overaged. AMS 4229 should, therefore, be considered as an alternate for applications currently specifying AMS 4228.

This specification is under the jurisdiction of AMS Committee "D".

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

AEROSPACE MATERIAL SPECIFICATION

AMS 4228A
Superseding AMS 4228
Issued 11-1-69
Revised 1-15-76

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ALUMINUM ALLOY CASTINGS, HIGH STRENGTH
4.5Cu - 0.7Ag - 0.30Mn - 0.25Mg - 0.25Ti (201.0-T6)
Solution and Precipitation Heat Treated

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 good ductility is is desired and optimum resistance to stress-corrosion cracking is not 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., 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 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:

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 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. 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 ø 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 and precipitation heat treated in such a manner as to ensure conformance to the requirements of 3.6. 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 ø to the requirements of 3.6.1.1 shall be used as basis for acceptance 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	5%

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	3%

3.6.1.1.3 Ø 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	5%

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.

3.7 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 Ø 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 Ø 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 Ø 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 repaired by plugging, peening, welding, or other methods without written permission from purchaser.

3.7.5.1 Ø 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.