Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 4226

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Revised

ALUMINUM ALLOY CASTINGS, HIGH STRENGTH
5.0Cu - 0.35Mn - 0.18Zr - 0.10V (224.0)
Solution and Precipitation Heat Treated (Overaged)

1. SCOPE:

1.1 Form: This specification covers an aluminum-base alloy in the form of high-strength sand, permanent mold, and composite mold castings of four classes.

1.2 Application: Primarily for components requiring a combination of high strength at room and elevated temperatures and good resistance to stress-corrosion cracking.

1.3 Classification: This specification covers four classes of aluminum-base alloy castings, defined by tensile property requirements in 3.6.1.1 and 3.6.1.2. The class or combination of classes supplied shall be as specified by the purchaser.

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., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2635 - Radiographic 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 E8 - Tension Testing of Metallic Materials
ASTM E21 - Short-Time Elevated Temperature Tension Tests of 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	4.5	5.5
Manganese	0.20	0.50
Zirconium	0.10	0.25
Vanadium	0.05	0.15
Titanium	--	0.35
Iron	--	0.10
Silicon	--	0.06
Boron	--	0.005
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 until 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 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 E8 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 overaged in such a manner as to ensure conformance to the requirements of 3.6 and 3.7. The solution heat treatment shall consist of heating to 930 F ± 10 (498.9 C ± 5.6), holding at heat for 5 hr ± 0.5, heating to 1000 F ± 10 (537.8 C ± 5.6), holding at heat for 24 hr ± 1, and quenching immediately in water at 150 F ± 5 (65.6 C ± 2.8). Castings and tensile test specimens shall then be overaged by heating to 375 F ± 10 (190.6 C ± 5.6), holding at heat for approximately 26 hr, and cooling. The exact time of overaging shall be adjusted as necessary to develop the required level of properties. 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:

3.6.1 Tensile Properties:

3.6.1.1 Specimens Cut from Castings: Shall conform to ASTM E8 and shall be either standard 0.500 in. (12.70 mm) diameter at the reduced parallel gage section or subsize specimens proportional to the standard, conforming to ASTM E8, or shall be standard sheet-type specimens.

3.6.1.1.1 At Room Temperature: Test specimens shall conform to the following requirements, determined in accordance with ASTM E8:

Designated Casting Areas

Class 1

Tensile Strength, min	50,000 psi (345 MPa)
Yield Strength at 0.2% Offset, min	37,000 psi (255 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	3%

Class 2

Tensile Strength, min	55,000 psi (379 MPa)
Yield Strength at 0.2% Offset, min	37,000 psi (255 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	5%

Other Casting Areas

Class 10

Tensile Strength, min	45,000 psi (310 MPa)
Yield Strength at 0.2% Offset, min	35,000 psi (241 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	2%

Class 11

Tensile Strength, min	50,000 psi (345 MPa)
Yield Strength at 0.2% Offset, min	37,000 psi (255 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	3%

3.6.1.1.1.1 Conformance to these requirements shall be used as basis for acceptance of castings.

3.6.1.1.2 At 450 F (232 C): Test specimens shall be capable of meeting the following requirements, determined in accordance with ASTM E21; specimens shall be heated to 450 F ± 2 (232.2 C ± 1.1), held at 450 F ± 2 (232.2 C ± 1.1) for 30 min. before testing, and tested at 450 F ± 2 (232.2 C ± 1.1):

Designated Casting Areas

Class 1

Tensile Strength, min	28,000 psi (193 MPa)
Yield Strength at 0.2% Offset, min	23,000 psi (159 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	8%

Class 2

Tensile Strength, min	31,000 psi (214 MPa)
Yield Strength at 0.2% Offset, min	23,000 psi (159 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	8%

Other Casting Areas

Class 10

Tensile Strength, min	25,000 psi (172 MPa)
Yield Strength at 0.2% Offset, min	22,000 psi (152 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	5%

Class 11

Tensile Strength, min	28,000 psi (193 MPa)
Yield Strength at 0.2% Offset, min	23,000 psi (159 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	8%

3.6.1.2 Separately Cast Test Specimens: The following requirements apply when separately cast specimens or integrally-cast specimens are required for determination of properties at room temperature; testing shall be in accordance with ASTM E8:

Tensile Strength, min	55,000 psi (379 MPa)
Yield Strength at 0.2% Offset, min	37,000 psi (255 MPa)
Elongation in 2 in. (50.8 mm) or 4D, min	5%

3.6.2 Stress-Corrosion Cracking Test: Castings shall be capable of showing no evidence of stress corrosion cracking when subjected to the following test:

3.6.2.1 A tensile specimen cut from a casting shall be 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, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication of parts.

3.7.2 Radiographic Inspection: Unless otherwise specified, castings shall be produced under radiographic control. 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 Radiographic and other quality standards shall be as agreed upon by purchaser and vendor.

3.7.4 Castings shall not be repaired by plugging, welding, or other methods, without written permission from purchaser.

3.7.5 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. Impregnated castings shall be marked IMP.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor 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.