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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4215F

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Superseding AMS 4215E

Submitted for recognition as an American National Standard

ALUMINUM ALLOY, CASTINGS
5.0Si - 1.2Cu - 0.50Mg (C355.0-T6)
Solution and Precipitation Heat Treated

UNS A33550

1. SCOPE:

1.1 Form:

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

1.2 Application:

These castings have been used typically for components requiring good strength at room and elevated temperatures, but usage is not limited to such application.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2635 Radiographic Inspection
AMS 2645 Fluorescent Penetrant Inspection
AMS 2694 Repair Welding of Aerospace Castings
AMS 2771 Heat Treatment of Aluminum Alloy Castings
AMS 2804 Identification, Castings

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 557	Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM B 557M	Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E 10	Brinell Hardness of Metallic Materials
ASTM E 34	Chemical Analysis of Aluminum and Aluminum Alloys
ASTM E 155	Reference Radiographs for Inspection of Aluminum and Magnesium Castings

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 34, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Silicon	4.5	5.5
Copper	1.0	1.5
Magnesium	0.40	0.6
Iron	--	0.20
Titanium	--	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 (See 3.5).

3.3 Casting:

(R)

Castings shall be produced in lots from metal conforming to 3.1. 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 conforms to 3.1. The type of mold for castings is not restricted.

3.3.1 A melt shall be the metal withdrawn from a batch-furnace charge of 2000 pounds (907 kg) or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 pounds (1814 kg) or less of metal withdrawn from one continuous furnace in not more than eight consecutive hours.

3.3.2 A lot shall be all castings poured from a single melt in not more than eight consecutive hours and solution and precipitation heat treated in the same heat treatment batch.

3.4 Cast Test Specimens:

Chemical analysis specimens and tensile specimens, when required, shall be cast as follows:

3.4.1 (R) Chemical Analysis Specimens: Shall be cast from each melt and shall be of any suitable size and shape appropriate to the test method.

3.4.2 (R) Tensile Specimens: When purchaser specifies use of separately-cast specimens, they shall be cast with each lot of castings, shall be of standard proportions conforming to ASTM B 557 or ASTM B 557M, 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.

3.5 (R) Heat Treatment:

Shall be in accordance with AMS 2771 except as follows:

3.5.1 (R) Solution Heat Treatment: Quenching medium shall be an aqueous polymer solution (15 to 30% polymer) or hot water at not lower than 150 °F (66 °C).

3.5.2 (R) Precipitation Heat Treatment: May begin immediately after quenching; product shall be at temperature for not less than three hours.

3.6 Properties:

Castings, and separately-cast tensile specimens when required, shall conform to the following requirements:

3.6.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B 557 or ASTM B 557M; conformance to the requirements of 3.6.1.1 shall be used as the basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.1.2 or 3.6.1.3 apply:

3.6.1.1 Specimens Cut From Any Area of a Casting: Specimens as in 4.3.3 shall have the properties shown in Table 2.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	35.0 ksi (241 MPa)
Yield Strength at 0.2% Offset	28.0 ksi (193 MPa)
Elongation in 4D	2%

3.6.1.2 Specimens Cut From Integrally-Cast Coupons: Specimens as in 4.3.3.1 shall have the properties shown in Table 3:

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	35.0 ksi (241 MPa)
Yield Strength at 0.2% Offset	28.0 ksi (193 MPa)
Elongation in 4D	2%

3.6.1.3 Separately-Cast Specimens: Specimens as in 4.3.4 shall have the properties shown in Table 4:

TABLE 4 - Minimum Tensile Properties

Property	Value
Tensile Strength	37.0 ksi (255 MPa)
Yield Strength at 0.2% Offset	30.0 ksi (207 MPa)
Elongation in 4D	1%

3.6.2 Hardness of Castings: Castings should have hardness of 75 to 110 HB/10/500 or 80 to 115 HB/10/1000, determined in accordance with ASTM E 10, 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 imperfections detrimental to usage of the castings.

3.7.1.1 (R) Castings shall have smooth surfaces and shall be cleaned sufficiently to permit nondestructive inspection.

3.7.2 Castings shall be subjected to radiographic examination in accordance with AMS 2635 or other inspection techniques acceptable to purchaser 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 (R) When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645.

3.7.4 Radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor. ASTM E 155 may be used to define radiographic acceptance standards.

3.7.5 Castings shall not be reworked 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 reworked by welding in accordance with AMS 2694.

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 for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the castings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Except as specified in 4.2.1.1, tests for composition (3.1), tensile properties of specimens cut from castings (3.6.1.1) or, when specified, from integrally-cast coupons (3.6.1.2) or tensile properties of separately-cast specimens (3.6.1.3), and quality (3.7) are acceptance tests and shall be performed to represent each melt or lot as applicable.

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

4.2.2 Periodic Tests: Tests for hardness (3.6.2) are 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 for all technical requirements are preproduction tests and shall be performed prior to or on the first-article shipment of a casting to a purchaser, when a change in ingredients and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be 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 activity, contracting officer, or request for procurement.

4.3 Sampling and Testing:

Shall be in accordance with the following:

4.3.1 One or more chemical analysis specimens in accordance with 3.4.1 from each melt or a casting from each lot.

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

4.3.3 (R) Not less than two tensile specimens machined from a casting or castings from each lot except when purchaser specifies use of integrally-cast coupons as in 4.3.3.1 or use of separately-cast specimens as in 4.3.4. Specimens shall conform to ASTM B 557 or ASTM B 557M and shall be either 0.500 inch (12.70 mm) diameter at the reduced parallel gage section, subsize specimens 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 from each lot.

4.3.3.1 (R) When permitted by purchaser, test bars integrally-cast with the castings may be tested in lieu of testing specimens cut from castings. Size, number, and location of integrally-cast coupons shall be as specified on the casting drawing or as agreed upon by purchaser and vendor.

4.3.4 When specified by purchaser, three separately-cast tensile specimens in accordance with 3.4.2 representing each lot of castings; one specimen shall be tensile tested and the other two retained for retests if necessary.

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 purchaser.

4.4.2 Vendor shall establish, for production of sample castings of each part number, parameters for the process control factors which will produce acceptable castings; these shall constitute the approved casting procedure and shall be used for producing production castings. If necessary to make any change in parameters for the process control factors, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, sample castings, test specimens, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.