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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4215G

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Superseding AMS 4215F

(R)

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 high strength at room and elevated temperatures, but usage is not limited to such application.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

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

AMS 2694 Repair Welding of Aerospace Castings
AMS 2771 Heat Treatment of Aluminum Alloy Castings
MAM 2771 Heat Treatment of Aluminum Alloy Castings (Metric)
AMS 2804 Identification, Castings

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

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 29	Using Significant Digits in Test Data to Determine Conformance with Specifications
ASTM E 34	Chemical Analysis of Aluminum and Aluminum Alloys
ASTM E 227	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique
ASTM E 607	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Point-to-Plane Technique, Nitrogen Atmosphere
ASTM E 716	Sampling Aluminum and Aluminum Alloys for Spectrochemical Analysis
ASTM E 1251	Optical Emission Spectrometric Analysis of Aluminum and Aluminum Alloys by the Argon Atmosphere, Point-to-Plane, Unipolar Self-Initiating Capacitor Discharge
ASTM E 1417	Liquid Penetrant Examination
ASTM E 1742	Radiographic Examination

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2175	Casting, Classification and Inspection of

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 in accordance with ASTM E 227, ASTM E 607, or ASTM E 1251, or by other analytical methods acceptable to purchaser (See 3.4.1).

TABLE 1 - Composition

Element	min	max
Silicon	4.5	5.5
Iron	--	0.20
Copper	1.0	1.5
Manganese	--	0.10
Magnesium	0.40	0.6
Zinc	--	0.10
Titanium	--	0.20
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.1.1 Test results may be rounded in accordance with the "rounding off" method of ASTM E 29.

3.2 Condition:

Solution and precipitation heat treated (See 3.5).

3.3 Casting:

Castings shall be produced from metal conforming to 3.1, determined by analysis of a specimen (3.4.1) cast after the last melt addition. The type of mold for castings is not restricted.

3.4 Cast Test Specimens:

Chemical analysis specimens and tensile specimens, when required, shall be cast after the last melt addition and shall be tested to qualify the melt lot as in 3.1.

3.4.1 Chemical Analysis Specimens: Shall be cast from each melt. Spectrochemical sample shall be prepared in accordance with ASTM E 716.

3.4.2 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. Chills are not permitted in the specimen cavity except on the end face of the specimen when approved in accordance with 4.4.2. A tensile specimen shall be processed with each heat treat lot and tested for conformance with 3.6.1.3.

3.5 Heat Treatment:

Castings and representative tensile specimens (3.4.2) shall be solution and precipitation heat treated in accordance with AMS 2771 or MAM 2771 except as follows:

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

3.6 Properties:

Castings and integrally-cast coupons or 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 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: When specified by purchaser, specimens from integrally-cast coupons 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: When specified by purchaser, 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%

3.7 Quality:

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 When acceptance standards are not specified, Grade C of MIL-STD-2175 shall apply.

3.7.2 Methods of inspection and frequency of inspection shall be as agreed upon by purchaser and vendor. A “Casting Class” of MIL-STD-2175 may be selected to specify the method and frequency of inspection.

3.7.3 Castings shall be produced under radiographic control. This control shall consist of 100% radiographic inspection of castings until process control factors (4.4.2) have been established to ensure production of acceptable castings. Unless otherwise specified by purchaser, continued radiographic inspection of production castings shall be performed at a frequency determined by the vendor to ensure continued maintenance of internal quality.

3.7.3.1 Radiographic inspection shall be conducted in accordance with ASTM E 1742, unless otherwise specified by purchaser.

3.7.4 When specified by purchaser, castings shall be fluorescent penetrant inspected using a method specified by purchaser, or, if not specified, a method in accordance with ASTM E 1417.

3.7.5 Castings shall not be peened, plugged, impregnated, or welded, unless authorized by purchaser.

3.7.5.1 When authorized by purchaser, welding in accordance with AMS 2694 or other welding program approved by purchaser may 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 the performance of 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 specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Except as specified in 4.2.1.1, composition (3.1) and 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), are acceptance tests and shall be performed to represent each melt or heat treat 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: Radiographic inspection (3.7.3) following the establishment of process control (4.4.2) is a periodic test and shall be performed at a frequency determined by the vendor to ensure continued maintenance of internal quality unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: 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 material, and/or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.3 Sampling and Testing:

Shall be in accordance with the following:

4.3.1 One chemical analysis specimen from each melt for conformance to 3.1.

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

4.3.3 Not less than two tensile specimens machined from a casting or castings from each heat treat lot for conformance to 3.6.1.1 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 When permitted by purchaser, test bars integrally-cast with the castings may be tested for conformance to 3.6.1.2 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 for conformance to 3.6.1.3 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. Vendor shall also establish a procedure for production of separately-cast tensile specimens. Method for production of separately cast tensile specimens shall be consistent for all material cast to this specification. Control factors for producing separately-cast tensile specimens need not be the same as those used for production of 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.

4.4.2.1 Control factors for producing castings include, but are not limited to, the following:

Type of furnace
Furnace atmosphere
Alloy additions, fluxing, deoxidation, and gas removal procedure
Gating, risering, and chilling practices
Mold composition and molding practice
Core composition and fabrication method, if applicable
Metal pouring temperature; variation of ±50 °F (±28 °C) from the established limit is permissible
Solidification and cooling procedures
Solution and precipitation heat treatment cycles
Cleaning operations
Straightening procedure, if applicable
Methods of inspection
Radiographic inspection sampling plan, if used.

4.4.2.1.1 Any of the above process control factors for which parameters are considered proprietary by the vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.