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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4219C

Issued MAR 1966
Revised JUL 1992
Reaffirmed JUL 2000

Superseding AMS 4219B

Aluminum Alloy Castings
7.0Si - 0.55Mg - 0.12Ti - 0.06Be (A357.0 T61)
Solution and Precipitation Heat Treated

UNS A13570

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 parts, such as hydraulic pumps or structural components requiring high strength, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

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.

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

2.1 SAE Publications:

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

AMS 2360	Room Temperature Tensile Properties of Castings
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

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-453	Inspection, Radiographic
MIL-STD-2175	Casting, Classification and Inspection of
MIL-STD-6966	Inspection, Liquid Penetrant

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	6.5	7.5
Magnesium	0.40	0.7
Titanium	0.04	0.20
Beryllium	0.04	0.07
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. 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.

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, integrally-cast coupons, and tensile specimens shall be cast as follows, and when requested, shall be supplied with the casting:

3.4.1 Chemical Analysis Specimens: Shall be cast from each melt and shall be of any suitable size, shape, and form.

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, with 0.500 inch (12.70 mm) or 0.250 inch (6.35 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 and shall be subjected to the same grain-refining or alloying treatment given the metal for the castings.

3.4.3 Integrally-Cast Coupons: When purchaser specifies use of integrally-cast coupons in lieu of specimens cut from castings, they shall be of the size, number, and location on the casting specified by purchaser.

3.5 Heat Treatment:

3.5.1 Solution Heat Treatment: Shall be in accordance with AMS 2771.

3.5.2 Precipitation Heat Treatment: Shall be in accordance with AMS 2771 except aging time shall be not less than three hours.

3.6 Properties:

Castings, integrally-cast coupons, and representative tensile 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 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 Castings:

3.6.1.1.1 Tensile specimens cut from any area of a casting shall have the properties shown in Table 2.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	38.0 ksi (262 MPa)
Yield Strength at 0.2% Offset	30.0 ksi (207 MPa)
Elongation in 4D	2%

3.6.1.1.2 When properties other than those of 3.6.1.1.1 are required, tensile specimens as in 4.3.3 machined from locations indicated on the drawing, from a casting or castings 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: Shall be as shown in Table 3.

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	41.0 ksi (283 MPa)
Yield Strength at 0.2% Offset	32.0 ksi (221 MPa)
Elongation in 4D	3.0%

3.6.1.3 Integrally-Cast Specimens: Unless otherwise specified by purchaser, properties shall be as in shown in Table 3.

3.6.2 Hardness of Castings: Castings should have hardness of 80 to 115 HB/10/500 or 85 to 120 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 in a casting having the nonconforming hardness value.

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 Castings shall have smooth surfaces and shall be well cleaned.

3.7.2 Castings shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with MIL-STD-453 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 MIL-STD-6866 or to other non-destructive inspection techniques acceptable to purchaser.

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 in accordance with MIL-STD-2175. When a radiographic grade is not specified, Grade C will apply.

3.7.5 Castings shall not be reworked by peening, plugging, welding, or other methods without written permission from purchaser (See 8.2).

3.7.5.1 When permitted in writing by purchaser, defects in castings resultant from the casting process may be removed and the castings repaired 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, for composition (3.1), tensile properties of specimens cut from castings (3.6.1.1) or, when specified, from integrally-cast coupons (3.6.1.3) or separately-cast specimens (3.6.1.2), 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 or integrally-cast coupons shall be determined only when specified by purchaser or when specimens cut from castings cannot be obtained. Tensile properties of separately-cast specimens or from integrally-cast coupons need not be determined when tensile properties of specimens cut from castings 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 material 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 chemical analysis specimen 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 Not less than two tensile specimens machined from a casting or castings from each lot except when purchaser specifies use of separately-cast specimens or integrally-cast coupons. 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. If casting size does not permit removal of test specimens, either integrally-cast or separately-cast test specimens shall be tested.

4.3.4 One separately-cast tensile specimen in accordance with 3.4.2 from each lot when purchaser specifies use of separately-cast specimens.

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.