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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4261D

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Submitted for recognition as an American National Standard

ALUMINUM ALLOY CASTINGS, INVESTMENT 7.0Si - 0.32Mg (356.0-T51) Precipitation Heat Treated

UNS A03560

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of investment castings.

1.2 Application: Primarily for small, intricate parts cast to approximately final dimensions.

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.

2.1.1 Aerospace Material Specifications:

AMS 2360 - Room Temperature Tensile Properties of Castings
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

2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Military Standards:

MIL-STD-2175 - Casting, Classification and Inspection of

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, Ø determined by wet chemical methods in accordance with ASTM E 34, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Silicon	6.5	7.5
Magnesium	0.20	0.45
Iron	--	0.6
Manganese	--	0.35
Zinc	--	0.35
Copper	--	0.25
Titanium	--	0.25
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Precipitation heat treated.

3.3 Casting: Castings shall be poured either from remelted metal from a master heat or directly from a master heat. In either case, metal for casting shall be qualified as in 3.4.

3.3.1 A master heat is refined metal of a single furnace charge or is metal blended as in 3.3.2. Gates, sprues, risers, and rejected castings shall be used only in preparation of master heats; they shall not be remelted directly, without refining, for pouring of castings. Ladle additions of small amounts of grain-refining elements or alloys are permissible.

3.3.2 Metal from two or more master heats may be blended provided that the Ø composition of each master heat to be blended is within the limits of 3.1 and that the total weight of metal blended does not exceed 15,000 pounds (6804 kg). When two or more master heats are blended, the resultant blend shall be considered a master heat.

3.4 Master Heat Qualification: Each master heat shall be qualified by evaluation of chemical analysis and tensile specimens conforming to 3.4.1 and 3.4.2, respectively. A master heat may be considered conditionally qualified if vendor's test results show conformance to all applicable requirements of this specification. However, except when purchaser waives confirmatory testing, final qualification shall be based on purchaser's test results. Conditional qualification of a master heat shall not be construed as a guarantee of acceptance of castings poured therefrom.

3.4.1 Chemical Analysis Specimens: Shall be of any convenient size, shape, and Ø form.

3.4.2 Tensile Specimens: Shall be cast from remelted metal from each master heat except that when castings are poured directly from a master heat the specimens shall also be poured directly from the master heat. Specimens shall be of standard proportions in accordance with ASTM B 557 or ASTM B 557M with 0.250 inch (6.35 mm) diameter at the reduced parallel gage section. They shall be cast to size or shall be cast oversize and subsequently machined to 0.250 inch (6.35 mm) diameter. Center gating may be used.

3.4.2.1 Separately-cast specimens, integrally-cast coupons, or specimens Ø machined from castings may be used for master heat qualification.

3.5 Heat Treatment: Castings and representative tensile specimens shall be heat Ø treated in accordance with AMS 2771.

3.6 Properties: Castings, integrally-cast coupons, and separately-cast tensile specimens 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 3.6.1.2 applies:

3.6.1.1 Separately-Cast Specimens and Integrally Cast Coupons: Ø

Tensile Strength, minimum	23.0 ksi (159 MPa)
Yield Strength at 0.2% Offset, minimum	16.0 ksi (110 MPa)
Elongation in 4D, minimum	3%

3.6.1.2 Specimens Cut from Castings: Specimens as in 4.3.4 shall have the Ø following properties:

Tensile Strength, minimum	17.5 ksi (121 MPa)
Yield Strength at 0.2% Offset, minimum	12.0 ksi (83 MPa)
Elongation in 4D, minimum	1%

3.6.1.2.1 When properties other than those of 3.6.1.2 are required, tensile specimens as in 4.3.4 taken 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.

3.6.2 Hardness: Castings, except at gate and riser locations, should have Ø hardness not lower than 50 HB/10/500 or 55 HB/10/1000, or equivalent, determined in accordance with ASTM E 10, but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.2 are met, as determined on a casting having the lowest hardness from each heat treatment lot.

3.7 Quality:

3.7.1 Castings, as received by purchaser, shall be uniform in quality and Ø condition, sound, and free from foreign materials and from imperfections that exceed the applicable radiographic and/or fluorescent penetrant inspection acceptance standards.

3.7.1.1 Castings shall have a uniform surface finish and shall be free of scale Ø and other visible surface contamination.

3.7.2 Castings shall be produced under radiographic control. 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 When specified, castings shall be subjected to fluorescent penetrant Ø inspection in accordance with AMS 2645.

3.7.4 Radiographic, fluorescent penetrant, and other quality standards shall be Ø as established by the cognizant engineering organization.

3.7.4.1 When radiographic acceptance standards are not specified, MIL-STD-2175 Ø Grade D shall apply.

3.7.5 Castings shall not be repaired by peening, plugging, welding, or other Ø methods without written permission from the cognizant engineering organization.

3.7.5.1 When permitted in writing by the cognizant engineering organization, Ø discontinuities in castings may be removed and the castings welded in accordance with AMS 2694.

3.7.6 Castings shall not be impregnated, chemically treated, or coated to Ø prevent leakage, unless specified or allowed by written permission of the cognizant engineering organization designating the method to be used.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of castings shall supply all Ø 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 conforms 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 Ø (3.1), tensile properties of separately-cast specimens (3.6.1.1), hardness (3.6.2), and quality (3.7.1) are acceptance tests and shall be performed on each master heat or lot as specified by 4.3.

4.2.1.1 Tensile properties of specimens cut from castings or from Ø integrally-cast coupons shall be determined only when specified by purchaser or when separately-cast specimens are not available. 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 radiographic inspection (3.7.2) and fluorescent Ø penetrant inspection (3.7.3) 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 Ø 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; a lot Ø shall be not more than 800 pounds (363 kg) of cast metal, including gates, sprues, and risers, produced in not more than five consecutive hours from a single master heat and precipitation heat treated in a heat treat batch:

4.3.1 At least one chemical analysis specimen in accordance with 3.4.1 from each Ø master heat or a casting from each lot.

4.3.2 At least one separately-cast tensile specimen in accordance with 3.4.2 Ø from each lot, except when properties of specimens machined from castings or from integrally-cast coupons are required.

4.3.3 At least one preproduction casting in accordance with 4.4.1 of each part Ø number.

4.3.4 Except as specified by 4.3.4.1, at least one casting from each lot when Ø properties machined from castings are required. Size, location, and number of specimens machined from castings shall be as specified on the drawing or as agreed upon by purchaser and vendor. When size, location, and number of specimens are not specified, not less than four tensile specimens, two from the thickest section and two from the thinnest section, shall be cut from a casting or castings representing each lot.

4.3.4.1 When permitted by purchaser, tensile specimens conforming to ASTM B 557 Ø or ASTM B 557M excised from integrally-cast coupons may be used in lieu of separately-cast specimens (4.3.2) or specimens cut from a casting or castings (4.3.4). Size, number, and location of integrally-cast coupons shall be as specified by purchaser.

4.4 Approval:

4.4.1 Sample castings from new or reworked master patterns 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, separately for tensile specimens used for master heat qualification and for production of sample castings of each part number, parameters for the process control factors which will produce tensile specimens meeting master heat qualification requirements and acceptable castings; these shall constitute the approved casting procedures and shall be used for producing subsequent master heat qualification specimens and 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, test specimens, sample castings, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.