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AEROSPACE MATERIAL SPECIFICATION

AMS 4260C
Superseding AMS 4260B

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ALUMINUM ALLOY CASTINGS, INVESTMENT
7.0Si - 0.32Mg (356.0-T6)
Solution and 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 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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2360 - Room Temperature Tensile Properties of Castings
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2646 - Contrast Dye Penetrant Inspection
AMS 2694 - Repair Welding of Aerospace Castings
AMS 2804 - Identification, Castings

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2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B557 - Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E34 - Chemical Analysis of Aluminum and Aluminum Alloys
ASTM E155 - Reference Radiographs for Inspection of Aluminum and Magnesium Castings, Series III

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.3.3 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

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 Ø spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by 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: Solution and 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 Unless prohibited by purchaser, metal from two or more master heats may be blended provided that the composition of each master heat to be blended is within the limits of 3.1 and that the total weight of metal blended does
Ø not exceed 10,000 lb (4500 kg). Ingot and pig may be blended together, shot may be blended, but shot shall not be blended with ingot or pig. 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
Ø 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 for vendor's tests. When chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and vendor.

3.4.2 Tensile Specimens: Shall be cast from remelted metal from each master heat except when castings are poured directly from a master heat, in which case the specimens shall also be poured directly from the master heat. Specimens shall be of standard proportions in accordance with ASTM B557 with 0.250 in. (6.25 mm) at the reduced parallel gage section. They shall be cast to size or shall be cast oversize and subsequently machined to 0.250 in. (6.25 mm) diameter. Center gating may be used.

3.5 Heat Treatment: No specific heat treating instructions are specified but castings and representative tensile specimens shall be solution and precipitation heat treated to produce the properties specified in 3.6.1 and
Ø 3.6.2. Recommended heat treatments are presented in 3.5.1 and 3.5.2. At least one set of tensile 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 three hours. Heat treatment equipment and controls shall be in accordance with MIL-H-6088.

3.5.1 Solution Heat Treatment: Heat to 1000°F ± 10 (540°C ± 5), hold at heat for
Ø 12 hr ± 0.5, and quench in hot (150° - 212°F (65° - 100°C)) water.

3.5.2 Precipitation Heat Treatment: Heat to 310°F ± 10 (155°C ± 5, hold at heat
Ø for 3 - 5 hr, and cool in air.

3.6 Properties: Castings 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 B557; 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 applies:

3.6.1.1 Separately-Cast Specimens:

Tensile Strength, min	33,000 psi (230 MPa)
Yield Strength at 0.2% Offset, min	22,000 psi (150 MPa)
Elongation in 4D, min	3%

3.6.1.2 Specimens Cut from Castings: When tensile properties of castings are determined, the average of not less than four, and preferably ten, specimens cut from thick and thin sections shall be as follows:

Tensile Strength, min	25,000 psi (170 MPa)
Yield Strength at 0.2% Offset, min	16,500 psi (115 MPa)
Elongation in 4D, min	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,
Ø 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 sprue and riser locations, should have
Ø hardness of 27 - 60 HRB, or equivalent, determined in accordance with ASTM E18, but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.2 are met.

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 internal and external imperfections detrimental to usage of the castings.

3.7.1.1 Castings shall have smooth surfaces and shall be well cleaned.
Ø Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.7.2 Castings shall be produced under radiographic control, unless otherwise specified. This control shall consist of radiographic examination of Ø castings in accordance with AMS 2635 until proper foundry technique, which will produce castings free from harmful 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 or to contrast dye penetrant inspection in accordance with AMS 2646.

3.7.4 Radiographic, fluorescent penetrant, contrast dye penetrant, and other Ø quality standards shall be as agreed upon by purchaser and vendor. ASTM E155 may be used to define radiographic acceptance standards.

3.7.5 Castings shall not be repaired 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 Ø 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 Ø required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product 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 to determine conformance to requirements for composition (3.1), tensile properties of Ø separately-cast specimens (3.6.1.1), hardness (3.6.2), and quality (3.7) are classified as acceptance tests and shall be performed on each master heat.

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

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests Ø and shall be performed on the first-article shipment of a casting to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when Ø requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following; a lot shall be not Ø more than 800 lb (365 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 treatment batch:

4.3.1 Two chemical analysis specimens in accordance with 3.4.1 from each master heat or a casting from each lot.

4.3.2 Three tensile specimens in accordance with 3.4.2 from each lot. Ø

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

4.3.4 One or more castings from each lot when properties are required from specimens machined from castings. Specimens shall conform to ASTM B557 and shall be either 0.250 in. (6.25 mm) diameter at the reduced parallel gage section, subsize specimens proportional to the standard, or standard Ø sheet-type specimens. For determining conformance to the requirements of 3.6.1.2.2, if specimen locations are not shown on the drawing, 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.

4.4 Approval:

4.4.1 Sample castings from new or reworked master patterns and the casting Ø 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 Ø procedure 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 by purchaser, sample test specimens, castings, 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 test specimens and castings include, but Ø are not limited to, the following:

Type of furnace and its capacity
Type and size of furnace charge
Time molten metal is in furnace
Furnace atmosphere
Fluxing or deoxidation procedure
Number of ladles used in pour
Mold refractory formulation
Mold back-up material
Gating practices
Mold preheat and pouring temperatures (variations of ±25°F (±15°C) from established limits are permissible)
Solidification and cooling procedures
Solution and precipitation heat treatment cycle
Cleaning operations
Methods of inspection

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

4.5 Reports:

4.5.1 The vendor of castings shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of at least one casting, or of specimens as in 3.4.1 cast in a mold with the parts, Ø from each master heat represented, the results of tests for tensile properties of separately-cast specimens representing each lot or of specimens cut from castings from each lot, and for hardness of castings from each lot. This report shall include the purchase order number, lot number, AMS 4260C, solution and precipitation heat treatment used, part number, and quantity.