Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4420K
Superseding AMS 4420J

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MAGNESIUM ALLOY CASTINGS, SAND
6Al - 3Zn (AZ63A-F)

1. SCOPE:

1.1 Form: This specification covers a magnesium alloy in the form of sand castings.

1.2 Application: Primarily for castings operating at temperatures up to 300°F (150°C).

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 Society of Automotive Engineers, Inc., 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 2475 - Protective Treatment, Magnesium Base Alloys
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2646 - Contrast Dye Penetrant Inspection
AMS 2804 - Identification, Castings

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 E10 - Brinell Hardness of Metallic Materials
ASTM E35 - Chemical Analysis of Magnesium and Magnesium Base Alloys
ASTM E155 - Reference Radiographs for Inspection of Aluminum and Magnesium Castings, Series III

2.3 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 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 E35, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Methods 112, or by other approved analytical methods:

	min	max
Aluminum	5.3	6.7
Zinc	2.5	3.5
Manganese	0.15	--
ø Silicon	--	0.30
Copper	--	0.10
Nickel	--	0.01
Other Impurities, total	--	0.30
Magnesium	remainder	

3.2 Condition: As cast.

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. If grain-refining elements are not added, the molten metal shall be subjected to superheating or other grain-refining treatment. Unless otherwise agreed upon by purchaser and vendor, 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 has been found to conform to 3.1.

3.3.1 A melt shall be the metal withdrawn from a batch furnace charge of 2000 lb (908 kg) or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 lb (1816 kg) or less of metal withdrawn from one continuous furnace in not more than 8 consecutive hours.

3.3.2 A lot shall consist of castings poured from a single melt in not more than 8 consecutive hours.

3.4 Cast Test Specimens: Chemical analysis specimens and tensile test specimens shall be cast as follows and, when requested, shall be supplied with the castings:

3.4.1 Chemical Analysis Specimens: Shall be cast from each melt and shall be of the size and shape agreed upon by purchaser and vendor.

3.4.2 Tensile Test Specimens: Shall be cast with each lot of castings, shall be of standard proportions conforming to ASTM B557 with 0.500 in. (12.70 mm) diameter at the reduced parallel gage ø section, and shall be cast to size in molds made with the regular foundry mix of green sand without using chills. 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.

3.5 Properties: Castings and representative tensile test specimens produced in accordance with 3.4.2 shall conform to the following requirements:

ø 3.5.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B557:

3.5.1.1 Separately-Cast Specimens:

Tensile Strength, min	26,000 psi (179 MPa)
Yield Strength at 0.2% Offset, min	11,000 psi (76 MPa)
Elongation in 4D min	4.0%

3.5.1.2 Specimens Cut From Castings:

3.5.1.2.1 When tensile properties of actual castings are determined for acceptance, the average of not less than 4, and preferably 10, specimens shall be as follows:

Tensile Strength, min	18,000 psi (124 MPa)
Elongation in 4D, min	1.0%

3.5.1.2.1.1 Conformance to these requirements may be used as basis for acceptance of castings.

3.5.1.2.2 When specified, tensile test specimens as in 4.3.4, from a casting chosen at random to represent Ø the lot, shall have the properties indicated on the drawing for each specimen. Property requirements for such specimens may be designated in accordance with AMS 2360.

3.5.2 Hardness: Except at sprue and riser locations, castings should have hardness not lower than Ø 48 HB/10/500, 48 HB/14.3/1000, or 57 HB/10/1000, determined in accordance with ASTM E10, but shall not be rejected on the basis of hardness if the tensile property requirements of 3.5.1.2.1 are met.

3.6 Quality:

3.6.1 Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the castings.

3.6.1.1 Castings cleaned by blasting shall be pickled in a sulfuric or sulfuric nitric acid solution to remove not less than 0.002 in. (0.05 mm) of metal before protective treatment, unless otherwise permitted by purchaser.

3.6.2 Castings shall be produced under radiographic control, unless otherwise specified. This control shall consist of radiographic examination of castings in accordance with AMS 2635 until proper Ø 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.

3.6.3 When specified, castings shall be subject to fluorescent penetrant inspection in accordance with Ø AMS 2645 and/or to contrast dye penetrant inspection in accordance with AMS 2646.

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

3.6.5 Castings shall not be repaired by peening, plugging, welding, or other methods without written per- Ø mission from the purchaser.

3.6.5.1 When permitted in writing by purchaser, defects in castings may be removed and the castings repaired by welding provided the weld repair area has properties comparable to those of the Ø parent metal. Repair welds shall be subjected to the same inspection procedures and acceptance standards required of the casting. Weld repair areas shall be suitable marked to facilitate inspection. The repair welding shall be performed prior to any nondestructive testing specified herein.

3.6.6 Castings shall not be impregnated, chemically treated, or coated to prevent leaking 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 and shall be responsible Ø for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to ensure that the castings conform to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests except that tensile properties of separately-cast specimens need not be determined when tensile tests are made on specimens cut from castings.

4.2.1 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, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Two chemical analysis specimens in accordance with 3.4.1 and/or a casting from each melt.

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

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

4.3.4 One or more castings from each lot when properties of specimens machined from castings are required. Specimens shall conform to ASTM B557 and shall be either 0.500 in. (12.70 mm) diameter at the reduced parallel gage section, subsize specimens proportional to the standard, or sheet-type specimens. For determining conformance to the requirements of 3.5.1.2.2, 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 from each lot.

4.4 Approval:

4.4.1 Sample castings from new or reworked patterns and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived.

4.4.2 Vendor shall establish for production of sample castings of each part number the control factors of processing 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 control factors of processing, 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
Mold material
Fluxing or deoxidation procedure
Gating and risering practices
Pouring temperature (variation of ±50°F (±30°C) from the established limit is permissible)
Solidification and cooling procedures
Cleaning operations
Methods of routine inspection

4.4.2.1.1 Any of the above control factors of processing considered proprietary by the vendor may be assigned a code designation. Each variation in such factors 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 separately-cast specimens from each melt and the results of tests for tensile properties of separately-cast test specimens representing each lot or specimens cut from castings from each lot. When tensile properties of sepcimens cut from castings are specified, the report shall include the results of tests to determine conformance to such requirements. This report shall include the purchase order number, lot number, material specification number and its revision letter, part number and quantity.