



AEROSPACE MATERIAL SPECIFICATION

AMS4424**REV. L**

Issued	1939-05
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Superseding AMS4424K

Magnesium Alloy Castings, Sand
6.0Al - 3.0Zn (AZ63-T6)
Solution and Precipitation Heat Treated
(Composition similar to UNS M11630)

RATIONALE

AMS4424L restores this document to active status and revises Composition (3.1), Chemical Analysis Specimens (3.4.1), Heat Treatment (3.5), Tensile Properties (3.6.1), Quality (3.7), Acceptance Tests (4.2.1), Sampling (4.3) and Protective Treatment (5.2), and Packaging (5.3), removes hardness as a technical requirement and provides information on expected hardness in 8.3, and is a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

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

1.2 Application

Primarily for parts operating in service up to 300 °F (150 °C).

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 cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2360 Room Temperature Tensile Properties of Castings

AMS2475 Protective Treatments, Magnesium Alloys

AMS2694 In-Process Welding of Castings

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AMS2768 Heat Treatment of Magnesium Alloy Castings

AMS2804 Identification, Castings

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 557	Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM B 953	Sampling Magnesium and Magnesium Alloys for Spectrochemical Analysis
ASTM B 954	Analysis of Magnesium and Magnesium Alloys by Atomic Emission Spectrometry
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E 155	Reference Radiographs for Inspection of Aluminum and Magnesium Castings
ASTM E 1220	Visible Penetrant Testing Using Solvent-Removable Process
ASTM E 1417/E 1417M	Liquid Penetrant Testing
ASTM E 1742/E 1742M	Radiographic Examination

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the following percentages by weight, determined by spectrochemical methods methods in accordance with B 954 or by other analytical methods acceptable to purchaser:

TABLE 1 - COMPOSITION

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

3.2 Condition

Solution and precipitation heat treated.

3.3 Castings

Castings shall be produced 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 or alloys are not added, the molten metal shall be subjected to superheating or other grain-refining treatment. Molten metal taken from alloying furnaces, with or without addition of foundry operating scrap (gate, 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 and tensile 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 after the last melt addition and shall be tested to qualify the melt lot as in 3.1.

3.4.2 Tensile Specimens

Shall be cast with each lot of castings, shall be of standard proportions conforming to ASTM B 557 with 0.500 inches (12.70 mm) diameter at the reduced parallel gage section, and shall be cast to size in molds made with the regular foundry mix of sand without using chills. Metal for the specimens shall be part of the metal which is used for the castings and shall be subjected to the same grain-refining or alloying treatment given the metal for the castings. The temperature of the metal during pouring of the specimens shall be not lower than that during pouring of the castings.

3.5 Heat Treatment

Castings and representative separately-cast tensile specimens shall be solution and precipitation heat treated in accordance with AMS2768; 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.

3.6 Properties

Castings, integrally-cast coupons, and representative separately-cast 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; conformance to the requirements of 3.6.1.1 shall be used as the basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.1.2 apply:

3.6.1.1 Separately-Cast Specimens

Tensile Strength, min	34 ksi (235 MPa)
Yield Strength at 0.2% Offset, min	16 ksi (110 MPa)
Elongation in 4D, min	3%

3.6.1.2 Specimens Cut from Castings or from Integrally-Cast Coupons

3.6.1.2.1 The average of not less than four, and preferably 10, specimens cut from thick and thin sections of a casting or castings shall be as follows; when permitted by purchaser, integrally-cast coupons may be used in lieu of specimens cut from castings and shall meet the following requirements:

Tensile Strength, min	25 ksi (175 MPa)
Yield Strength at 0.2% Offset, min	14 ksi (100 MPa)
Elongation in 4D, min	0.75%

3.6.1.2.2 Any specimen cut from a casting or from an integrally-cast coupon shall meet the following requirements:

Tensile Strength, min	17 ksi (115 MPa)
Yield Strength at 0.2% Offset, min	12 ksi (85 MPa)

- 3.6.1.2.3 When properties other than those specified in 3.6.1.2.1 and 3.6.1.2.2 are required, tensile specimens as in 4.3.4, machined from locations indicated on the drawing from a casting or castings chosen at random to represent the lot or from integrally-cast coupons attached to such castings, shall have the properties indicated on the drawing for such specimens. Property requirements may be designated in accordance with AMS2360.

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.
- 3.7.1.2 Castings cleaned by blasting shall be pickled in a sulfuric or sulfuric-nitric acid solution to remove not less than 0.002 inches (0.05 mm) of metal before protective treatment as in 5.2.
- 3.7.2 Castings shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with ASTM E 1742/E 1742M 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 ASTM E 1417/E 1417M, to contrast dye penetrant inspection in accordance with ASTM E 1220, or to both.
- 3.7.4 Radiographic, fluorescent penetrant, contrast dye 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.
- 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 removed and the castings repaired by welding in accordance with AMS2694.
- 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. 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 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, tests to determine conformance to requirements for composition (3.1), tensile properties (3.6.1.1), and quality (3.7) are classified as acceptance tests and shall be performed to represent each melt or lot as applicable.

- 4.2.1.1 Tensile properties of specimens cut from castings or from 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 Preproduction Tests

Tests to determine conformance to all technical requirements of this specification are classified as 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, processing, or both requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.

4.3 Sampling

Shall be in accordance with the following:

- 4.3.1 Two chemical analysis specimens in accordance with 3.4.1 and ASTM B 953 from each melt for conformance to 3.1.
- 4.3.2 One separately-cast tensile specimen in accordance with 3.4.2 from each lot except when purchaser requires properties of specimens cut from castings or from integrally-cast coupons.
- 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 or, when permitted by purchaser, four or more integrally-cast coupons. Specimens shall conform to ASTM B 557 and shall be either 0.500 inches (12.70 mm) diameter at the reduced parallel gage section, subsize specimens proportional to the standard, or standard sheet-type specimens. For determining conformance to the requirements of 3.6.1.2.3, 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 or from integrally-cast coupons attached to such castings.

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 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, separately-cast tensile specimens, sample 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 castings include, but are not limited to, the following:

Type of furnace
Furnace atmosphere
Gating and risering practices
Fluxing or deoxidation procedure
Metal pouring temperature; variation of ± 50 °F (± 30 °C) from the established limit is permissible
Solidification and cooling procedures
Solution and precipitation heat treatment cycles
Cleaning operations
Methods of inspection

- 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.