SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4434L

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Superseding AMS 4434K

Magnesium Alloy Castings, Sand
9.0Al - 2.0Zn (AZ92-T6)
Solution and Precipitation Heat Treated

(Composition similar to UNS M11920)

1. SCOPE:

1.1 Form:

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

1.2 Application:

These castings have been used typically for parts operating in service up to 300 °F (149 °C), but usage is not limited to such application.

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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2360	Room Temperature Tensile Properties of Castings
AMS 2475	Protective Treatments, Magnesium Alloys
AMS 2694	Repair Welding of Aerospace Castings
AMS 2804	Identification, Castings
AMS-M-6857	Magnesium Alloy Castings, Heat Treatment of
AS1990	Aluminum Alloy Tempers

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

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 35	Chemical Analysis of Magnesium and Magnesium Alloys
ASTM E 155	Reference Radiographs for Inspection of Aluminum and Magnesium Castings
ASTM E 1417	Liquid Penetrant Examination
ASTM E 1742	Radiographic Examination

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 35, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

TABLE 1 - Composition

Element	min	max
Aluminum	8.3	9.7
Zinc	1.6	2.4
Manganese	0.10	--
Silicon	--	0.30
Copper	--	0.10
Nickel	--	0.01
Other Elements, each	--	0.10
Other Elements, total	--	0.30
Magnesium	remainder	

3.1.1 Determination of residual elements is not required for routine acceptance.

3.2 Condition:

Solution and precipitation heat treated to the T6 temper (see AS1990) in accordance with AMS-M-6857.

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. 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 treat 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 and shall be of suitable size, shape, and form.

3.4.2 Tensile Specimens: 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) 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 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. The temperature of the molten metal during pouring of the specimens shall be not lower than that during pouring of the castings.

3.5 Heat Treatment:

Castings and representative tensile specimens shall be solution and precipitation heat treated in accordance with AMS-M-6857; at least one set of tensile specimens shall, during each stage of heat treatment, be placed 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 and 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 or ASTM B 557M; 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: Specimens as in 4.3.2 shall have the properties shown in Table 2.

TABLE 2 – Minimum Tensile Properties

Property	Value
Tensile Strength	34.0 ksi (234 MPa)
Yield Strength at 0.2% Offset	18.0 ksi (124 MPa)
Elongation in 4D	1.0%

3.6.1.2 Specimens Cut from Castings:

3.6.1.2.1 The average of not less than four, and preferably ten, specimens cut from thick and thin sections determined on specimens as in 4.3.4, shall be as shown in Table 3::

TABLE 3 – Minimum Tensile Properties

Property	Value
Tensile Strength	25.5 ksi (176 MPa)
Yield Strength at 0.2% Offset	16.0 ksi (110 MPa)
Elongation in 4D	0.75%

3.6.1.2.2 Any specimen cut from a casting shall meet the values shown in Table 4.

TABLE 4 – Minimum Tensile Values

Property	Value
Tensile Strength	17.0 ksi (117 MPa)
Yield Strength at 0.2% Offset	13.0 ksi (93 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 designated 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.

3.7 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 sufficiently cleaned to permit fluorescent penetrant examination.

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 inch (0.05 mm) of metal.

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, or other radiographic procedures acceptable to purchaser, 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 1417.

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.

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

3.7.5.1 When authorized by purchaser, defects in castings may be removed and the castings reworked 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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the castings conform to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), tensile properties of separately-cast specimens (3.6.1.1) or, when specified, tensile properties of specimens cut from castings (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 specimens cut from castings 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 are determined.

4.2.2 Preproduction Tests: 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.

4.3 Sampling and Testing:

Shall be in accordance with the following:

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

4.3.2 One separately-cast tensile specimen in accordance with 3.4.2 from each lot. If purchaser requires properties of specimens cut from castings, testing of separately-cast tensile specimens is not required.

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 tensile properties are required from specimens cut from castings. 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, sub-size specimens proportional to the standard, or standard sheet-type specimens. For determining conformance to the requirements of 3.6.1.2, 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 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, test specimens, sample castings, or both. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

4.4.2.1 Process control factors for producing castings include, but are not limited to the following; supplier's procedures shall identify tolerances, ranges, and/or control limits, as applicable:

Type of furnace
Furnace atmosphere
Grain refining practice
Maximum amount of alloy per melt lot
Alloy additions, fluxing, deoxidation, and gas removal procedures
Gating and risering practices
Mold composition and molding practice
Core composition and fabrication method, when applicable
Metal pouring temperature; variation of ±50 °F (±28 °C) from the established limit is permissible
Solidification and cooling procedures
Solution and precipitation heat treatment cycles
Cleaning operations
Methods of inspection
Radiographic inspection sampling plan, if used.

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.

4.5 Reports:

The vendor of castings shall furnish with each shipment a report showing the results of tests for composition of at least one casting or of separately-cast specimens from each melt and for tensile properties of separately-cast specimens representing each lot or of specimens cut from castings from each lot, and stating that the castings conform to the other technical requirements. This report shall include the purchase order number, lot number, AMS 4434L, part number, and quantity. The report shall also identify the foundry.

4.6 Resampling and Retesting:

If any specimen used in the above tests fails to meet the specified requirements, disposition of the castings may be based on the results of testing two additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the castings represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Shall be in accordance with AMS 2804.

5.1.1 Impregnated castings shall be marked "IMP".