AEROSPACE MATERIAL SPECIFICATION

AMS4443™	REV. J

Issued 1956-07
Revised 2017-06
Stabilized 2024-07

Superseding AMS4443H

Magnesium Alloy, Sand Castings
4.5Zn - 0.75Zr (ZK51A-T5)
Precipitation Heat Treated
(Composition similar to UNS M16510)

RATIONALE

AMS4443J hast been declared "STABILIZED" by AMS Committee D Nonferrous Alloys. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because Committee D can find no producers for this document.

NOTE: Previously this document was revised. The last technical update of this document occurred in June 2017. Users of this document should refer to the cognizant engineering organization for disposition of any issues with reports/certifications to the specification; including exceptions listed on the certification. In many cases, the purchaser may represent a sub tier supplier and not the cognizant engineering organization.

STABILIZED NOTICE

AMS4443J has been declared “STABILIZED” by SAE AMS Committee D Nonferrous Alloys and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

TO PLACE A DOCUMENT ORDER:
Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

For more information on this standard, visit
https://www.sae.org/standards/content/AMS4443J/

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 requiring a combination of good yield strength and elongation, but usage is not limited to such applications.

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 +1 724-776-4970 (outside USA), www.sae.org.

AMS2175 Castings, Classification and Inspection of

AMS2360 Room Temperature Tensile Properties of Castings

AMS2475 Protective Treatments Magnesium Alloys

AMS2768 Heat Treatment of Magnesium Alloy Castings

AMS2694 In-Process Welding of Castings

AMS2804 Identification Castings

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

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 B557 Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products

ASTM B557M Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products (Metric)

ASTM B953 Sampling Magnesium and Magnesium Alloys for Spectrochemical Analysis

ASTM B954 Analysis of Magnesium and Magnesium Alloys by Atomic Emission Spectrometry

ASTM E10 Brinell Hardness of Metallic Materials

ASTM E29 Using Significant Digits in Test Data to Determine Conformance with Specifications

ASTM E155 Reference Radiographs for Examination of Aluminum and Magnesium Castings

ASTM E1417/E1417M Liquid Penetrant Testing

ASTM E1742/E1742M Radiographic Examination

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1, determined by spectrochemical methods in accordance with ASTM B954, or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Zinc	3.6	5.5
Zirconium, total	0.50	1.0
Copper	--	0.10
Nickel	--	0.01
Other Elements, each (3.1.1)	--	0.10
Other Elements, total (3.1.1)	--	0.30
Magnesium	remainder	

3.1.1 Determination not required for routine acceptance.

3.1.2 Test results may be rounded by the “rounding off” method of ASTM E29.

3.2 Condition

Precipitation heat treated.

3.3 Casting

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 shall be added to the melt. 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 or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 4000 pounds or less of metal withdrawn from one continuous furnace in not more than 8 consecutive hours.

3.3.2 A lot shall be all castings poured from a single melt in not more than 8 consecutive hours and solution and precipitation heat treated in the same heat treat batch.

3.4 Test Specimens

Chemical analysis specimens and tensile specimens shall be cast as follows:

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 prepared as follows and tested for conformance to 3.6.1:

3.4.2.1 Unless specimens cut from castings are specified by the purchaser, separately cast specimens, conforming to ASTM B557 or ASTM B557M, shall be cast from each melt after the last melt addition. Specimens shall be cast in molds representing the mold formulation used for castings. Chills are not permitted on test specimen cavity except on the end face of the specimen when approved in accordance with 4.4.2. Tensile specimens shall be processed with each heat treat lot.

3.4.2.2 When purchaser specifies specimens cut from castings or from integrally cast coupons, such specimens shall be removed after heat treatment, shall be machined to conform to ASTM B557 or ASTM B557M, and shall be either 0.500 inch (12.70 mm) diameter at the reduced parallel gage section, subsize specimens proportional to the standard, or standard sheet-type specimens.

3.5 Heat Treatment

Shall be in accordance with AMS2768. Unless specimens cut from castings or from integrally-cast coupons are specified, 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 3 hours.

3.6 Properties

Castings, integrally-cast coupons, and representative separately-cast tensile specimens shall conform to the following requirements:

3.6.1 Tensile Properties

Shall be as follows, determined in accordance with ASTM B557 or ASTM B557M; conformance to the requirements of 3.6.1.1 shall be used as the basis for acceptance of castings except when purchaser specifies that specimens shall be cut from castings (see 3.6.1.2) or from integrally-cast coupons (see 3.6.1.2).

3.6.1.1 Separately-Cast Specimens

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	20.0 ksi (138 MPa)
Elongation in 4D	5%

3.6.1.2 Specimens Cut from Castings or from Integrally-Cast Coupons

When specified by purchaser, specimens obtained by sampling in accordance with 4.3.4 shall meet the requirements of Table 3, unless otherwise specified as in 3.6.1.2.1.

Table 3 - Minimum tensile properties

Property	Value
Tensile Strength	24.0 ksi (165 MPa)
Yield Strength at 0.2% Offset	14.0 ksi (96 MPa)
Elongation in 4D	1.25%

3.6.1.2.1 Properties other than those shown in Table 3, may be specified for specific casting locations. Properties 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 sufficiently cleaned to permit fluorescent penetrant inspection.

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 prior to protective treatment as in 5.2.

3.7.2 Castings shall be produced under radiographic control. This control shall consist of 100% radiographic inspection of castings until process control factors (4.4.2) have been established to ensure production of acceptable castings. Unless otherwise specified by the purchaser, continued radiographic inspection of production castings shall be performed at a frequency determined by the vendor to assure continued maintenance of internal quality.

3.7.3 Methods of inspection and frequency of inspection shall be as agreed upon by purchaser and vendor. A “Casting Class” of AMS2175 may be selected to specify the method and frequency of inspection.

3.7.4 When acceptance standards are not specified, Grade C of AMS2175 shall apply and radiographic indications of gas holes, sand spots, and inclusions shall be cause for rejection when closer to the edge than twice their maximum dimension. ASTM E155 may be used to define radiographic acceptance standards.

3.7.5 Radiographic inspection shall be conducted in accordance with ASTM E1742/E1742M, unless otherwise specified by purchaser.

3.7.6 When specified by purchaser, castings shall be fluorescent penetrant inspected using a method specified by the purchaser, or, if not specified, a method in accordance with ASTM E1417/E1417M.

3.7.7 Castings shall not be peened, plugged, impregnated, or welded unless authorized by purchaser.

3.7.7.1 When authorized by purchaser, welding in accordance with AMS2694 or other welding program approved by the purchaser may 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 the specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Except as specified in 4.2.1.1, composition (3.1), tensile properties of separately-cast specimens (3.6.1.1) or, when specified, tensile properties of specimens cut from castings or integrally-cast coupons (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 or from integrally-cast coupons shall be determined 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

Radiographic inspection (3.7.2) following the establishment of process control (4.4.2) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 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 One chemical analysis specimen in accordance with 3.4.1 and with ASTM B953, 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 machined from castings or from integrally-cast coupons.

4.3.3 One or more preproduction castings in accordance with 4.4.1 of each part number.

4.3.4 Except as permitted by 4.3.4.1, one or more castings from each lot when tensile properties are required from specimens machined from castings. For determining conformance to the requirements of 3.6.1.2, if specimen locations are not shown on the drawing, two specimens from the thickest section, and two from the thinnest section, shall be cut from a casting or castings from each lot.

4.3.4.1 When permitted by purchaser, tensile specimens conforming to ASTM B557 or ASTM B557M 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 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. Vendor shall also establish a single procedure for production of separately-cast tensile specimens. Method for production of separately-cast tensile specimens shall be consistent for all material cast to this specification. Control factors for separately cast tensile specimens must generally represent, but need not be identical to, those factors used for 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
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) is permissible
Solidification and cooling procedures
Precipitation heat treatment cycle
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 each melt and for tensile properties of a separately-cast specimen representing each lot or of specimens cut from castings from each lot, and stating that the castings conform to the other acceptance technical requirements and, when performed, the periodic tests. This report shall include the purchase order number, lot number, AMS4443J, part number, and quantity.

4.5.1 When material produced to this specification is beyond the sizes allowed in the scope or tables, or other exceptions are taken to the technical requirements listed in Section 3, (see 5.1.2) the report shall contain a statement "This material is certified as AMS4443J(EXC) because of the following exceptions:" and the specific exceptions shall be listed.