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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-4426

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An American National Standard

CASTINGS, SAND, MAGNESIUM ALLOY
5.1Y – 3.0Re – 0.70Zr (WE54 – T6)
Solution and Precipitation Heat Treated

UNS M18410

1. SCOPE:

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

1.2 Application: Primarily for parts requiring high yield strength up to 570°F (299°C) and excellent corrosion resistance.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS-2360 – Room Temperature Tensile Properties of Castings
AMS-2361 – Elevated Temperature Tensile Properties of Castings
AMS-2475 – Protective Treatments, Magnesium Alloys
AMS-2635 – Radiographic Inspection
AMS-2645 – Fluorescent Penetrant Inspection
AMS-2694 – Repair Welding of Aerospace Castings
AMS-2750 – Pyrometry
AMS-2804 – Identification, Castings

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2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

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 10 – Brinell Hardness of Metallic Materials
ASTM E 21 – Elevated Temperature Tension Tests of Metallic Materials
ASTM E 35 – Chemical Analysis of Magnesium and Magnesium Alloys
ASTM E 155 – Reference Radiographs for Inspection of Aluminum and Magnesium Castings

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E 35, by spectrochemical method, or by other analytical methods acceptable to purchaser:

	min	max
Yttrium	4.75	5.5
Rare Earths (See 3.1.1)	2.0	4.0
Zirconium Total	0.40	1.0
Zirconium Soluble (3.1.2, 3.1.3)	0.40	—
Zinc	—	0.2
Lithium	—	0.2
Manganese	—	0.15
Copper	—	0.03
Iron	—	0.01
Silicon	—	0.01
Nickel	—	0.005
Other Impurities, total	—	0.30
Magnesium	remainder	

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3.1.1 Rare earths consist of neodymium 1.5 – 2.0% by weight, remainder being principally heavy rare earths ytterbium, erbium, dysprosium, and gadolinium. Heavy rare earth fraction is directly related to the yttrium content of the alloy (i.e. yttrium is present as nominal 80% by weight, 20% by weight HRE mixture).

3.1.2 Soluble zirconium is that portion of the zirconium which is soluble in 1:4 hydrochloric acid held below its boiling point.

3.1.3 Determination not required for routine acceptance.

3.2 Condition: Solution and precipitation heat treated.

3.3 Casting: Furnace or ladle additions of grain-refining elements or alloys are required. Castings shall be produced from metal conforming to 3.1. 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:

3.4.1 Chemical Analysis Specimens: Shall be cast from each melt and shall be of any suitable size and shape.

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. If the metal for castings is given any treatment, such as fluxing or cooling and reheating, the metal for the specimens shall be a portion of the metal so treated and, during such treatment, shall be heated to the same maximum temperature and held for approximately the same time as the molten metal for the castings. 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 tensile specimens shall be heated to a temperature not exceeding 985°F (529°C), held at heat for the proper time for solution heat treatment, and quenched as required, reheated to a temperature between 470° – 490°F (243° – 254°C), and held at heat for the proper time for precipitation heat treatment. 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. Pyrometry shall be in accordance with AMS-2750.

3.6 Properties: Castings and representative separately-cast tensile specimens produced in accordance with 3.4.2 shall conform to the following requirements:

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3.6.1 Tensile Properties: Conformance to the requirements of 3.6.1.1.1 shall be used as the basis for acceptance of castings except when purchaser specifies that the requirements of 3.6.1.1.2 apply:

3.6.1.1 At Room Temperature: Shall be as follows, determined in accordance with ASTM B 557 or ASTM B 557M:

3.6.1.1.1 Separately-Cast Specimens:

Tensile Strength, minimum	36,000 psi (248 MPa)
Yield Strength at 0.2% offset, minimum	25,000 psi (172 MPa)
Elongation in 4D, minimum	2.0%

3.6.1.1.2 Specimens Cut From Castings: Shall be as follows, determined on specimens as in 4.3.4:

Tensile Strength, minimum	35,000 psi (241 MPa)
Yield Strength at 0.2% Offset, minimum	25,000 psi (172 MPa)
Elongation in 4D, minimum	2.0%

3.6.1.2 At 480°F (249°C): Shall be as follows, determined in accordance with ASTM E 21 on specimens heated to 480°F ± 5 (249°C ± 3), held at heat for not less than 10 minutes before testing, and tested at 480°F ± 5 (249°C ± 3):

3.6.1.2.1 Separately-Cast Specimens:

Tensile Strength, minimum	30,000 psi (207 MPa)
Yield Strength at 0.2% Offset, minimum	23,000 psi (159 MPa)

3.6.1.2.2 Specimens Cut From Castings:

Tensile Strength, minimum	28,000 psi (193 MPa)
Yield Strength at 0.2% Offset, minimum	22,000 psi (152 MPa)

3.6.1.3 When properties other than those specified in 3.6.1.1.2 and 3.6.1.2.2 are required, tensile specimens as in 4.3.4 taken from 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 for such specimens may be designated in accordance with AMS 2360, AMS 2361, or both.

3.6.2 Hardness: Castings, except at sprue and riser locations, should have hardness of 62 – 85 HB/10/500 or 67 – 90 HB/10/1000, determined in accordance with ASTM E 10, but the castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.1.2 are met.

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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 be well cleaned.

3.7.1.2 Castings cleaned by blasting shall, prior to nondestructive inspection, be pickled in a sulfuric or sulfuric-nitric acid solution to remove not less than 0.002 inch (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 AMS-2635 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 AMS-2645.

3.7.4 Radiographic, fluorescent penetrant, and other quality standards for acceptance 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, impregnation, or other methods without written permission from purchaser.

3.7.5.1 When permitted in writing by purchaser, in-process welding in accordance with AMS-2694 may be used.

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. 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 for composition (3.1), tensile properties at room temperature (3.6.1.1), hardness (3.6.2), and quality (3.7) are acceptance tests and shall be performed to represent each melt or lot as applicable.

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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 Periodic Tests: Tests for tensile properties at 480°F (249°C)(3.6.1.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests for 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.

4.2.3.1 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, contracting officer, or request for procurement.

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, a casting from each lot, or both.

4.3.2 Three tensile specimens in accordance with 3.4.2 from each lot except when purchaser requires properties of specimens cut from castings.

4.3.3 One preproduction casting in accordance with 4.4.1 of each part number for dimensional evaluation; additional castings shall be provided, when specified by purchaser, for property and quality evaluation.

4.3.4 One or more castings from each lot when properties are required of 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, subsize specimens proportional to the standard, or standard sheet-type specimens. For determining conformance to the requirements of 3.6.1.3, 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.

4.3.5 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 three 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 and no additional testing shall be permitted. Results of all tests shall be reported.

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