SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE MAM 4427A

Issued JUL 1992
Reaffirmed OCT 2000
Cancelled MAR 2003

Superseding MAM 4427

Magnesium Alloy Sand Castings
4.0Y - 2.3Nd - 0.7Zr (WE43A - T6)
Solution and Precipitation Heat Treated

UNS M18430

SAENORM.COM : Click to view the full PDF of mam4427a

CANCELLATION NOTICE

This specification has been declared “CANCELLED” by the Aerospace Materials Division, SAE, as of March, 2003. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications.

AMS 4427 covers the same material.

“CANCELLED” specifications are available from SAE.

SAE Technical Standards Board Rules provide that: “This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user.”

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright 2003 Society of Automotive Engineers, Inc.
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

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**

1. SCOPE:

1.1 Form:

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

1.1.1 AMS 4427 is the inch/pound version of this MAM.

1.2 Application:

These castings have been used typically for parts requiring a combination of light weight, high yield strength up to 300 °C, and relatively high corrosion resistance, but usage is not limited to such applications.

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.

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

2.1 (Continued):

AMS 2750	Pyrometry
AMS 2804	Identification, Castings

2.2 ASTM Publications:

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

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

SAENORM.COM : Click to view the full PDF of mam4427a

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
Yttrium	3.7	4.3
Neodymium	2.0	2.5
Zirconium	0.40	1.0
Other Rare Earths (3.1.1)	--	1.9
Zinc	--	0.2
Lithium	--	0.2
Manganese	--	0.15
Copper	--	0.03
Iron	--	0.01
Silicon	--	0.01
Nickel	--	0.005
Other Impurities, total (3.1.2)	--	0.30
Magnesium	remainder	

SAENORM.COM : Click to view the full PDF of mam4427a

3.1.1 Other rare earths shall be the total of ytterbium, erbium, dysprosium, and gadolinium (See 8.1).

3.1.2 Determination not required for routine acceptance.

3.2 Condition:

Solution and precipitation heat treated to T6 temper.

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 900 kilograms or less as melted for pouring castings or, when permitted by purchaser, a melt shall be 1800 kilograms 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, shape, or form.

3.4.2 Tensile Specimens: Shall be cast with each lot of castings, shall be of standard proportions conforming to ASTM B 557M with 12.50 millimeter 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. 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 the proper temperature not exceeding 530 °C, held at heat for the proper time for solution treatment, quenched as required, and reheated to a temperature between 245 °C to 255 °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:

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 shown in 3.6.1.1.1 or 3.6.1.1.2, determined in accordance with ASTM B 557M.

3.6.1.1.1 Separately-Cast Specimens: Shall meet the requirements of Table 2.

SAENORM.COM : Click to view the full PDF of mam4427a

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	220 MPa
Yield Strength at 0.2% Offset	170 MPa
Elongation in 4D	2.0%

3.6.1.1.2 Specimens Cut from Castings or From Integrally-Cast Coupons: Specimens as in 4.3.4 shall meet the requirements of Table 3.

TABLE 3 - Minimum Tensile Properties

Property	Value
Tensile Strength	215 MPa
Yield Strength at 0.2% Offset	150 MPa
Elongation in 4D	2.0%

3.6.1.2 At 250 °C: Shall be as shown in 3.6.1.2.1 or 3.6.1.2.2, determined in accordance with ASTM E 21 on specimens heated to 250 °C ± 3, held at heat for not less than 10 minutes before testing, and tested at 250 °C ± 3.

3.6.1.2.1 Separately-Cast Specimens: Shall be as shown in Table 4.

SAENORM.COM : Click to view the full PDF of mam4427a

TABLE 4 - Minimum Tensile Properties

Property	Value
Tensile Strength	190 MPa
Yield Strength at 0.2% Offset	160 MPa

3.6.1.2.2 Specimens Cut From Castings or From Integrally-Cast Coupons: Specimens as in 4.3.4 shall meet the requirements of Table 5.

TABLE 5 - Minimum Tensile Properties

Property	Value
Tensile Strength	175 MPa
Yield Strength at 0.2% Offset	125 MPa

3.6.1.3 When properties other than those specified in Table 3 and Table 5 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 may be designated in accordance with AMS 2360, AMS 2361, or both.

3.6.2 Hardness: Castings, except at gate 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 minimum hardness if the tensile property requirements of 3.6.1.1.2 are met on castings exhibiting out-of-range hardness.

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 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 0.05 millimeter 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, 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 AMS 2645.

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.

SAENORM.COM : Click to view the full PDF of mam4427a

3.7.5.1 When permitted in writing by purchaser, defects in castings may be removed and the castings reworked by welding in accordance with AMS 2694. When authorized, rework welding shall be done before heat treatment.

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), 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 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 Periodic Tests: Tests for tensile properties at 250 °C (3.6.1.2) and hardness (3.6.2) 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 One chemical analysis specimen in accordance with 3.4.1 from each melt or a casting from each lot.

SAENORM.COM : Click to view the full PDF of mam4427a

4.3.2 One separately-cast tensile specimens 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; one casting for dimensional evaluation and the other for property and quality evaluation as required for approval as in 4.4.1.

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 cut from castings. Specimens shall conform to ASTM B 557M and shall be either 12.50 millimeter 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.

4.3.4.1 When permitted by purchaser, tensile specimens conforming to ASTM B 557 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. 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 Control factors for producing castings include, but as not limited to, the following:

Type of furnace
Furnace atmosphere
Sand formulation
Ladle addition or grain refining practice
Fluxing or oxide removal procedure
Gating and risering practices
Metal pouring temperature; variation of ±30 C degrees is permissible
Solidification and cooling procedures
Solution and precipitation heat treatment cycles
Cleaning operations
Methods of inspection

SAENORM.COM : Click to view the full PDF of mam4427a