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AEROSPACE MATERIAL SPECIFICATION

AMS 4362D
Superseding AMS 4362C

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MAGNESIUM ALLOY FORGINGS
5.5Zn - 0.45Zr (ZK60A-T5)
Precipitation Heat Treated

UNS M16600

1. SCOPE:

1.1 Form: This specification covers a magnesium alloy in the form of die forgings, hand forgings, and forging stock.

1.2 Application: Primarily for parts requiring high strength-to-weight ratio for service up to 300°F (150°C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

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

2.1.1 Aerospace Material Specifications:

AMS 2201 - Tolerances, Aluminum and Aluminum Alloy Bar, Rod, Wire, and Forging Stock, Rolled or Cold Finished
MAM 2201 - Tolerances, Metric, Aluminum and Aluminum Alloy Bar, Rod, Wire, and Forging Stock, Rolled, Drawn, or Cold Finished
AMS 2350 - Standards and Test Methods
AMS 2375 - Control of Forgings Requiring First Article Approval
AMS 2475 - Protective Treatments, Magnesium Alloys
AMS 2630 - Ultrasonic Inspection, Product Over 0.5 in. (12.5 mm) Thick
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2808 - Identification, Forgings

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B557 - Tension Testing Wrought and Cast Aluminum- and Magnesium-Alloy Products
ASTM E35 - Chemical Analysis of Magnesium and Magnesium Alloys

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Specifications:

MIL-M-6857 - Magnesium Alloy Castings, Heat Treatment of

2.3.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E35 or by spectographic or other analytical methods approved by purchaser:

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	min	max
Zinc	4.8	6.2
Zirconium	0.45	-
Residual Elements, each	-	0.10
Residual Elements, total	-	0.30
Magnesium	remainder	

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Die and Hand Forgings: Precipitation heat treated without prior solution heat treatment.

3.2.2 Forging Stock: As ordered by the forging manufacturer.

3.3 Heat Treatment: Forgings shall be precipitation heat treated by heating to 300°F ± 15 (150°C ± 8), holding at heat for not less than 24 hr, and cooling Ø in air. Furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-M-6857.

3.4 Properties: The product shall conform to the following requirements, determined in accordance with ASTM B557:

3.4.1 Tensile Properties:

3.4.1.1 Die Forgings: Shall be as follows, determined on specimens machined from forgings 3 in. (75 mm) and under in nominal thickness at time of heat treatment with axis of specimen in the area of gage length varying not more than 15 deg from parallel to the forging flow lines, on specimens machined from separately-forged coupons or from forging stock representing the forgings and, in either case, heat treated with the forgings, or on specimens machined from prolongations on heat treated forgings:

Tensile Strength, min	42,000 psi (290 MPa)
Yield Strength at 0.2% Offset, min	26,000 psi (180 MPa)
Elongation in 4D, min	7%

3.4.1.1.1 Tensile property requirements for specimens machined from forgings over 3 in. (75 mm) in nominal thickness at time of heat treatment and for specimens with orientation of the axis varying more than 15 deg from parallel to the forging flow lines shall be as agreed upon by purchaser and vendor.

3.4.1.2 Hand Forgings: Shall be as follows, determined on specimens taken from forgings 6 in. (150 mm) and under in nominal thickness with axis of specimen in the area of gage length varying not more than 15 deg from parallel to the forging flow lines and in such a manner as to represent the center of the forgings:

Tensile Strength, min	38,000 psi (260 MPa)
Yield Strength at 0.2% Offset, min	20,000 psi (140 MPa)
Elongation in 4D, min	7%

3.4.1.2.1 Tensile property requirements for specimens machined from forgings over 6 in. (150 mm) in nominal thickness and for specimens with orientation of the axis varying not more than 15 deg from parallel to the forging flow lines shall be as agreed upon by purchaser and vendor.

3.4.1.3 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.1. If specimens taken from the stock after heat treatment as in 3.3 conform to the requirements of 3.4.1.1, the tests shall be accepted as equivalent to tests of a forged coupon. The forging stock supplier, however, shall not be required to conduct such tests.

3.5 Quality: The product, 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 product.

3.5.1 Ø When specified, forgings shall be subjected to ultrasonic inspection in accordance with AMS 2630 and, unless otherwise specified, shall conform to the following requirements of AMS 2630:

3.5.1.1 Die forgings 0.50 to 3.00 in. (12.5 to 75.0 mm), incl, in nominal thickness and weighing not over 300 lb (135 kg) shall meet Class B.

3.5.1.2 Hand forgings 1.00 to 6.00 in. (25.0 to 150.0 mm), incl, in nominal thickness and weighing not over 600 lb (270 kg) shall meet Class A.

3.5.2 When specified, die forgings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645. Acceptance standards shall be as agreed upon by purchaser and vendor.

3.6 Tolerances: Tolerances for forging stock shall conform to all applicable requirements of AMS 2201 or MAM 2201.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product 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 product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot:

4.2.1.1 Composition (3.1) of the product.

4.2.1.2 Tensile properties (3.4.1.1 or 3.4.1.2) of forgings.

4.2.1.3 Tolerances (3.6) of forging stock.

4.2.2 Periodic Tests: Tests of forging stock to determine ability to develop specified properties (3.4.1.3) are classified as 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 of forgings to determine conformance to all applicable technical requirements of this specification when AMS 2375 is specified are classified as preproduction tests and shall be performed prior to or on the first-article shipment of a forging to a purchaser, when a change in material, processing, or both requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

4.2.3.1 For direct U.S. Military procurement of forgings, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

4.3 Sampling: Shall be as follows; a lot shall be all forgings of the same nominal cross-section and configuration heat treated in the same batch-furnace load or in a continuous furnace during an 8-hr period.

4.3.1 Composition: At least one sample shall be taken by the producer from each Ø group of ingots poured simultaneously from the same source of molten metal. Complete ingot analysis records shall be available to purchaser at the producer's facility.

4.3.1.1 Unless compliance with 4.3.1 is established, an analysis shall be made for each 4000 lb (1800 kg) or less of material comprising the lot except that not more than one analysis shall be required per piece.

4.3.2 Tensile Properties:

4.3.2.1 Die Forgings: At least one separately-forged coupon or one forging prolongation heat treated with each lot of forgings.

4.3.2.1.1 In lieu of a prolongation or separately-forged coupon, tensile specimens cut from a forging representing each lot from the location designated on the drawing or as specified by purchaser.

4.3.2.2 Hand Forgings: At least two tensile specimens taken from a forging or forging prolongation representing the lot.

4.3.2.3 Forging Stock: As agreed upon by purchaser and vendor.

4.4 Approval: When specified, approval and control of forgings shall be in accordance with AMS 2375.

4.5 Reports:

4.5.1 The vendor of forgings shall furnish with each shipment a report stating Ø that the chemical composition conforms to the specified requirements, showing the results of tests on each lot to determine conformance to the tensile property requirements, and stating that the forgings conform to the other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 4362D, size or part number, and quantity.

4.5.2 The vendor of forging stock shall furnish with each shipment a report stating that the chemical composition of the stock conforms to the requirements of this specification. This report shall include the purchase order number, AMS 4362D, size, and quantity.

4.5.3 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4362D, contractor or other direct supplier of forgings, part number, and quantity. When forgings for making parts are produced or purchased by the parts vendor, that vendor shall inspect each lot of forgings to determine conformance to