



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 4132B
Superseding AMS 4132A

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ALUMINUM ALLOY FORGINGS

2.3Cu - 1.6Mg - 1.1Fe - 1.0Ni - 0.18Si - 0.07Ti (2618-T61)

1. SCOPE:

- 1.1 Form: This specification covers an aluminum alloy in the form of die forgings, hand forgings, rolled rings, and forging stock.
- 1.2 Application: Primarily for rotor parts operating at temperatures up to 450° F (232° C) and other parts operating up to 600° F (316° C) at low stresses.

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

- 2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 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 Drawn
AMS 2350 - Standards and Test Methods
AMS 2375 - Approval and Control of Critical Forgings
AMS 2630 - Ultrasonic Inspection
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 E10 - Brinell Hardness of Metallic Materials
ASTM E34 - Chemical Analysis of Aluminum and Aluminum-Base Alloys

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

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.3.3 Military Standards:

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

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3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E34, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

| ∅ | | min | max |
|---|-------------------------|------|-----------|
| | Copper | 1.9 | - 2.7 |
| | Magnesium | 1.3 | - 1.8 |
| | Iron | 0.9 | - 1.3 |
| | Nickel | 0.9 | - 1.2 |
| | Silicon | 0.10 | - 0.25 |
| | Titanium | 0.04 | - 0.10 |
| | Zinc | -- | 0.10 |
| | Other Impurities, each | -- | 0.05 |
| | Other Impurities, total | -- | 0.15 |
| | Aluminum | | remainder |

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

3.2.1 Die Forgings, Rolled Rings, and Hand Forgings 4 In. (102 mm) and Under in Nominal Thickness: Solution and precipitation heat treated.

3.2.2 Hand Forgings Over 4 In. (102 mm) in Nominal Thickness: As forged.

3.2.3 Forging Stock: As ordered by the forging manufacturer.

3.3 Heat Treatment: Die forgings and rolled rings, and hand forgings 4 in. (102 mm) and under in nominal thickness shall be solution and precipitation heat treated in accordance with MIL-H-6088 except that the soaking time at solution heat treatment temperature shall be not less than 6 hours.

3.4 Properties: The product shall conform to the following requirements:

3.4.1 Forgings:

∅ 3.4.1.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM B557:

3.4.1.1.1 Test Specimens: Test specimens, machined from separately-forged coupons or from forging stock representing the forgings and, in either case, heat treated with the forgings or machined from prolongations on heat treated die forgings, shall have the following properties:

| | |
|--|----------------------|
| Tensile Strength, min | 58,000 psi (400 MPa) |
| Yield Strength at 0.2% Offset, min | 48,000 psi (331 MPa) |
| Elongation in 2 in. (50.8 mm) or 4D, min | 6% |

3.4.1.1.2 Die Forgings:

3.4.1.1.2.1 With Grain Flow: Test specimens, machined from forgings not over 4 in. (102 mm) in nominal thickness at time of heat treatment with axis of specimen in the area of gage length within 15 deg (0.262 rad) of parallel to the forging flow lines, shall have properties as specified in 3.4.1.1.1 except that elongation may be as low as 4%.

3.4.1.1.2.2 Across Grain Flow: Test specimens, machined from forgings not over 4 in. (102 mm) in nominal thickness at time of heat treatment with axis of specimen in the area of gage length varying more than 15 deg (0.262 rad) from parallel to the forging flow lines, shall have the following properties:

| | |
|--|----------------------|
| Tensile Strength, min | 55,000 psi (379 MPa) |
| Yield Strength at 0.2% Offset, min | 45,000 psi (310 MPa) |
| Elongation in 2 in. (50.8 mm) or 4D, min | 4% |

3.4.1.1.3 Rolled Rings:

3.4.1.1.3.1 Tangential: Test specimens, machined from rolled rings not over 4 in. (102 mm) in nominal thickness at time of heat treatment with the axis of specimen tangential to the ring circumference (approximately parallel to the direction of rolling), shall have the following properties:

| | |
|--|----------------------|
| Tensile Strength, min | 55,000 psi (379 MPa) |
| Yield Strength at 0.2% Offset, min | 41,000 psi (283 MPa) |
| Elongation in 2 in. (50.8 mm) or 4D, min | 6% |

3.4.1.1.3.2 Axial: Test specimens, machined from rolled rings not over 4 in. (102 mm) in nominal thickness at time of heat treatment with the axis of specimen parallel to the axis of the ring (transverse to direction of rolling), shall have properties as specified in 3.4.1.1.3.1 except that elongation may be as low as 5%.

3.4.1.1.4 Hand Forgings: Test specimens, machined from hand forgings having an essentially square or rectangular cross section not exceeding 144 sq. in. (929 cm²) and heat treated in the indicated thickness, shall have properties as specified in Table I provided the as-forged thickness does not exceed 4 in. (102 mm).

TABLE I

| Nominal Thickness At Time of Heat Treatment Inches | Specimen Orientation | Tensile Strength psi, min | Yield Strength at 0.2% Offset psi, min | Elongation in 2 in. or 4D %, min |
|--|----------------------|---------------------------|--|----------------------------------|
| Up to 2, incl | Longitudinal | 58,000 | 47,000 | 7 |
| | Long Transverse | 55,000 | 42,000 | 5 |
| | Short Transverse | 52,000 | 42,000 | 4 |
| Over 2 to 3, incl | Longitudinal | 57,000 | 46,000 | 7 |
| | Long Transverse | 55,000 | 42,000 | 5 |
| | Short Transverse | 52,000 | 42,000 | 4 |
| Over 3 to 4, incl | Longitudinal | 56,000 | 45,000 | 7 |
| | Long Transverse | 53,000 | 40,000 | 5 |
| | Short Transverse | 51,000 | 39,000 | 4 |

TABLE I (SI)

| Nominal Thickness At Time of Heat Treatment Millimetres | Specimen Orientation | Tensile Strength MPa, min | Yield Strength at 0.2% Offset MPa, min | Elongation in 50.8 mm or 4D %, min |
|---|-------------------------|---------------------------------|---|--|
| Up to 51, incl | Longitudinal | 400 | 324 | 7 |
| | Long Transverse | 379 | 290 | 5 |
| | Short Transverse | 359 | 290 | 4 |
| Over 51 to 76, incl | Longitudinal | 393 | 317 | 7 |
| | Long Transverse | 379 | 290 | 5 |
| | Short Transverse | 359 | 290 | 4 |
| Over 76 to 102, incl | Longitudinal | 386 | 310 | 7 |
| | Long Transverse | 365 | 276 | 5 |
| | Short Transverse | 352 | 269 | 4 |

3.4.1.1.5 Large Forgings: Tensile properties of forgings over 4 in. (102 mm) in nominal section thickness shall be as agreed upon by purchaser and vendor.

3.4.1.2 Hardness: Should be not lower than 115 HB/10/500 or 115 HB/14.3/1000, or not lower than 120 HB/10/1000, determined in accordance with ASTM E10, but forgings shall not be rejected on the basis of hardness if the applicable tensile property requirements are met.

3.4.2 Forging Stock: When a sample of stock is forged to a test coupon and heat treated in the same manner as forgings, specimens taken from the heat treated coupon shall conform to the requirement of 3.4.1.1.1. If a specimen taken from the stock after heat treatment in the same manner as forgings conforms to the requirements of 3.4.1.1.1, the test 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 shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

3.5.1 When specified, forgings and rolled rings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645 and/or to ultrasonic inspection in accordance with AMS 2630. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.6 Tolerances: Unless otherwise specified, tolerances for forging stock shall conform to all applicable requirements of AMS 2201.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples 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 perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests of the product to determine conformance to composition (3.1) requirements and of forgings to determine conformance to tensile property (3.4.1.1) requirements are classified as acceptance or routine control tests.