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400 Commonwealth Drive, Warrendale, PA 15096-0001

# AEROSPACE MATERIAL SPECIFICATION

**SAE**

**AMS 4125H**

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Superseding AMS 4125G

Submitted for recognition as an American National Standard

## ALUMINUM ALLOY DIE FORGINGS, AND ROLLED OR FORGED RINGS

0.90Si - 0.62Mg - 0.25Cr (6151-T6)

Solution and Precipitation Heat Treated

UNS A96151

### 1. SCOPE:

- 1.1 Form: This specification covers an aluminum alloy in the form of die forgings, rolled or forged rings, and stock for forgings and rings.
- 1.2 Application: Primarily for complex-shaped parts requiring moderate strength and good forgeability of the material. Corrosion resistance of this alloy is superior to that of the copper-containing alloys.

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 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 2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
- MAM 2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings, Metric (SI) units
- AMS 2645 - Fluorescent Penetrant Inspection
- AMS 2808 - Identification, Forgings

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

ASTM B 594 - Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications

ASTM B 660 - Packing/Packaging of Aluminum and Magnesium Products

- 2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight, determined in accordance with AMS 2355 or MAM 2355:

|                         | min       | max  |
|-------------------------|-----------|------|
| Silicon                 | 0.6       | 1.2  |
| Magnesium               | 0.45      | 0.8  |
| Chromium                | 0.15      | 0.35 |
| Iron                    | --        | 1.0  |
| Copper                  | --        | 0.35 |
| Zinc                    | --        | 0.25 |
| Manganese               | --        | 0.20 |
| Titanium                | --        | 0.15 |
| 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 and Rolled or Forged Rings: Solution and precipitation heat treated in accordance with MIL-H-6088.

- 3.2.2 Forging Stock: As ordered by the forging manufacturer.

- 3.3 Properties: The product shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355:

3.3.1 Forgings:

- 3.3.1.1 Tensile Properties: Shall be as follows:

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3.3.1.1.1 Die Forgings:

- 3.3.1.1.1.1 With Grain Flow: Specimens, machined from forgings not over 4 inches (102 mm) in nominal thickness at time of heat treatment with axis of specimen in area of gage length varying not more than 15 degrees from parallel to the forging flow lines, shall meet the following requirements:

|                                        |                    |
|----------------------------------------|--------------------|
| Tensile Strength, minimum              | 44.0 ksi (303 MPa) |
| Yield Strength at 0.2% Offset, minimum | 37.0 ksi (255 MPa) |
| Elongation in 4D, minimum              | 10%                |
| in 5D, minimum                         | 9%                 |

- 3.3.1.1.1.2 Across Grain Flow: Specimens, machined from forgings not over 4 inches (102 mm) in nominal thickness at time of heat treatment with axis of specimen in area of gage length varying not more than 15 degrees from perpendicular to the forging flow lines, shall have the following properties:

|                                        |                    |
|----------------------------------------|--------------------|
| Tensile Strength, minimum              | 44.0 ksi (303 MPa) |
| Yield Strength at 0.2% Offset, minimum | 37.0 ksi (255 MPa) |
| Elongation in 4D, minimum              | 6%                 |
| in 5D, minimum                         | 5%                 |

3.3.1.1.2 Rolled or Forged Rings:

- 3.3.1.1.2.1 Tangential: Specimens, machined from rings not over 2.5 inches (63.5 mm) in nominal thickness at time of heat treatment with axis of specimen tangential to the ring circumference (approximately parallel to the direction of rolling), shall have the following properties:

|                                        |                    |
|----------------------------------------|--------------------|
| Tensile Strength, minimum              | 44.0 ksi (303 MPa) |
| Yield Strength at 0.2% Offset, minimum | 37.0 ksi (255 MPa) |
| Elongation in 4D, minimum              | 5%                 |
| in 5D, minimum                         | 4%                 |

- 3.3.1.1.2.2 Axial: Specimens, machined from rings not over 2.5 inches (63.5 mm) in nominal thickness at time of heat treatment with axis of specimen parallel to axis of ring (transverse to direction of rolling), shall have the following properties:

|                                        |                    |
|----------------------------------------|--------------------|
| Tensile Strength, minimum              | 44.0 ksi (303 MPa) |
| Yield Strength at 0.2% Offset, minimum | 35.0 ksi (241 MPa) |
| Elongation in 4D, minimum              | 4%                 |
| in 5D, minimum                         | 3%                 |

- 3.3.1.1.3 Large Forgings and Rings: Tensile properties of die forgings over 4 inches (102 mm) or rings over 2.5 inches (63.5 mm) in nominal section thickness at time of heat treatment shall be as agreed upon by purchaser and vendor.

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- 3.3.1.1.4 Test Specimens: 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, minimum              | 44.0 ksi (303 MPa) |
| Yield Strength at 0.2% Offset, minimum | 37.0 ksi (255 MPa) |
| Elongation in 4D, minimum              | 14%                |
| in 5D, minimum                         | 12%                |

- 3.3.1.2 Hardness: Should be not lower than 90 HB/10/500 or 96 HB/10/1000, or equivalent; but forgings shall not be rejected on the basis of hardness if the applicable tensile property requirements are met.

- 3.3.2 Stock for Forgings or Rings: When a sample of stock is forged to a test coupon having a degree of mechanical working not greater than the forging and heat treated in the same manner as forgings or rings, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.1.4 and 3.3.1.2. If specimens taken from the stock after heat treatment in the same manner as forgings conform to the requirements of 3.3.1.1.4 and 3.3.1.2, the tests shall be accepted as equivalent to tests of a forged coupon.

- 3.4 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.

- 3.4.1 Each die forging and when specified, each rolled or forged ring shall be etched to produce a surface suitable for visual inspection. Surfaces shall be evaluated for defects and, if defects can be removed so they do not reappear on re-etching and if the required section thickness is maintained, the forgings and rings are acceptable.

- 3.4.1.1 When approved by purchaser, a sampling plan may be used in lieu of etching each die forging and/or ring.

- 3.4.2 When specified, die forgings and rolled or forged rings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645 and/or ultrasonic inspection in accordance with ASTM B 594. Standards for acceptance shall be as agreed upon by purchaser and vendor.

- 3.4.3 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings, showing no evidence of re-entrant grain flow.

- 3.5 Tolerances: Forging stock shall conform to all applicable requirements of AMS 2201 or MAM 2201.

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#### 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. 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 for the following requirements are acceptance tests and shall be performed on each lot:

4.2.1.1 Composition (3.1).

4.2.1.2 Tensile properties (3.3.1.1) and, when specified, fluorescent penetrant and/or ultrasonic inspection (3.4.2) of each lot of forgings or rings.

4.2.1.3 Visual surface inspection (3.4.1) of each die forging and when specified each rolled or forged ring.

4.2.1.4 Tolerances (3.5) of stock for forgings or rings.

4.2.2 Periodic Tests: Tests for the following requirements are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser:

4.2.2.1 Hardness (3.3.1.2) of forgings and rings.

4.2.2.2 Ability of stock for forging or rings to develop required properties (3.3.2).

4.2.2.3 Grain flow (3.4.3) of die forgings.

4.3 Sampling and Testing: Shall be in accordance with AMS 2355 or MAM 2355. A lot shall be all forgings or rings of the same part number, size, or nominal cross-section and configuration, heat treated in the same batch-furnace load or quenched from a continuous furnace consecutively during an eight-hour period. Maximum lot size for forgings heat treated in a continuous furnace shall be 6000 pounds (2722 kg).

#### 4.4 Reports:

4.4.1 The vendor of forgings or rings shall furnish with each shipment a report stating that the chemical composition conforms to the requirements of this specification and showing the results of tests on each lot to determine conformance to the other acceptance test requirements. This report shall include the purchase order number, lot number, AMS 4125H, size or part number, and quantity.