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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4127H

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Superseding AMS 4127G

Submitted for recognition as an American National Standard

Aluminum Alloy, Forgings and Rolled or Forged Rings (6061-T6) Solution and Precipitation Heat Treated

UNS A96061

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of die forgings, hand forgings, forged rings, rolled rings, and stock for forgings and rings.

1.2 Application:

These products have been used typically for complex, shaped parts requiring moderate strength and good forgeability of the material, but usage is not limited to such applications. Corrosion resistance of this alloy is superior to that of alloys having copper as the principal alloying element.

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 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
MAM 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings, Metric (SI) Units
AMS 2808	Identification, Forgings

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 594 Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications
ASTM E 1417 Liquid Penetrant Examination

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-H-6088 Heat Treatment of Aluminum Alloys

2.4 ANSI Publications:

Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products
ANSI H35.2M Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined in accordance with AMS 2355 or MAM 2355.

TABLE 1 - Composition

Element	min	max
Silicon	0.40	0.8
Iron	--	0.7
Copper	0.15	0.40
Manganese	--	0.15
Magnesium	0.8	1.2
Chromium	0.04	0.35
Zinc	--	0.25
Titanium	--	0.15
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition:

The product shall be supplied in the following condition:

3.2.1 Die Forgings, Hand 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 Die Forgings, Hand Forgings, and Rolled or Forged Rings:

3.3.1.1 Tensile Properties: Shall be as follows:

3.3.1.1.1 Die Forgings: Shall have the properties shown in Table 2 with tensile specimens machined from forgings not over 4 inches (102 mm) in nominal thickness at time of heat treatment with axis of specimens as follows:

3.3.1.1.1.1 With Grain Flow: Axis of grain flow in area of gage length varying not more than 15 degrees from parallel to the forging flow lines.

3.3.1.1.1.2 Across Grain Flow: Axis of grain flow in area of gage length varying not more than 15 degrees from perpendicular to the forging flow lines.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
With Grain Flow	38.0	35.0	7
Across Grain Flow	38.0	35.0	5

TABLE 2B - Minimum Tensile Properties, SI Units

Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 5D %
With Grain Flow	262	241	6
Across Grain Flow	262	241	4

3.3.1.1.2 Hand Forgings: Specimens, machined from forgings having an essentially square or rectangular cross-section heat treated in the indicated thickness, shall have the properties shown in Table 3 provided the as-forged thickness does not exceed 8 inches (203 mm) and the cross-sectional area is not over 256 square inches (1652 cm^2).

TABLE 3A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness at Time of Heat Treatment Inches	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
Up to 2, incl	Longitudinal	38.0	35.0	10
	Long-Trans.	38.0	35.0	8
Over 2 to 4, incl	Longitudinal	38.0	35.0	10
	Long-Trans.	38.0	35.0	8
	Short-Trans.	37.0	33.0	5
Over 4 to 8, incl	Longitudinal	37.0	34.0	8
	Long-Trans.	37.0	34.0	6
	Short-Trans.	35.0	32.0	4

TABLE 3B - Minimum Tensile Properties, SI Units

Nominal Thickness at Time of Heat Treatment Millimeters	Specimen Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 5D %
Up to 51, incl	Longitudinal	262	241	9
	Long-Trans.	262	241	7
Over 51 to 102, incl	Longitudinal	262	241	9
	Long-Trans.	262	241	7
	Short-Trans.	255	228	4
Over 102 to 203, incl	Longitudinal	255	234	7
	Long-Trans.	255	234	5
	Short-Trans.	241	221	3

3.3.1.1.3 Rolled or Forged Rings: Specimens machined in the indicated orientation from rings 3.5 inches (89 mm) and under in nominal thickness at time of heat treatment and having an OD-to-wall thickness ratio of 10:1 or greater shall have the minimum properties shown in Table 4.

TABLE 4A - Minimum Tensile Properties, Inch/Pound Units

Specimen Orientation	Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 4D %
Tangential (Note 1)	Up to 3.5, incl	38.0	35.0	
	Up to 2.5, incl			10
	Over 2.5 to 3.5, incl			8
Axial (Note 2)	Up to 3.5, incl	38.0	35.0	
	Up to 2.5, incl			8
	Over 2.5 to 3.5, incl			6
Radial (Note 3)	Up to 3.5, incl	37.0	33.0	
	Up to 2.5, incl			5
	Over 2.5 to 3.5, incl			4

(Note 1) Tangential: Axis of specimen tangential to ring OD (axis parallel to direction of rolling).
(Note 2) Axial: Axis of specimen parallel to axis of ring (axis transverse to direction of rolling).
(Note 3) Radial: Axis of specimen parallel to radius of ring, when specified.

TABLE 4B - Minimum Tensile Properties, SI Units

Specimen Orientation	Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 5D %
Tangential (Note 1)	Up to 89, incl	262	241	
	Up to 64, incl			9
	Over 64 to 89, incl			7
Axial (Note 2)	Up to 89, incl	262	241	
	Up to 64, incl			7
	Over 64 to 89, incl			5
Radial (Note 3)	Up to 89, incl	255	228	
	Up to 64, incl			5
	Over 64 to 89, incl			4

(Note 1) Tangential: Axis of specimen tangential to ring OD (axis parallel to direction of rolling).
(Note 2) Axial: Axis of specimen parallel to axis of ring (axis transverse to direction of rolling).
(Note 3) Radial: Axis of specimen parallel to radius of ring, when specified.

3.3.1.1.4 Test Specimens: Specimens machined from separately-forged coupons or from stock representing the forgings or rings and, in either case, heat treated with the forgings or rings, shall have the properties shown in Table 5.

TABLE 5 - Minimum Tensile Properties

Tensile Strength	Value
Yield Strength at 0.2% Offset	38.0 ksi (262 MPa)
	35.0 ksi (241 MPa)
Elongation in 4D (Note 1)	10%

(Note 1) SI Values - Elongation in 5D would require 9% minimum value

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

3.4.2 When specified, die forgings, hand forgings, and rings shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the following requirements:

3.4.2.1 Die Forgings: Class B.

3.4.2.2 Hand Forgings and Rings: Class A.

3.4.3 When specified, each forging and ring shall be subjected to fluorescent penetrant inspection in accordance with ASTM E 1417. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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

3.5 Tolerances:

Stock for forging or rings shall conform to all applicable requirements of ANSI H35.2 or ANSI H35.2M.

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 the performance of 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 specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: The following requirements are acceptance tests and except for composition, shall be performed on each inspection lot.

4.2.1.1 Composition (3.1).

4.2.1.2 Tensile properties (3.3.1.1) of each inspection lot.

4.2.1.3 Visual inspection (3.4.1) of each die forging and, when specified, each ring.

4.2.1.4 When specified, ultrasonic inspection (3.4.2) and/or fluorescent penetrant inspection (3.4.3) of each forging or ring.

4.2.1.5 Tolerances (3.5) of stock for forging or rings.

4.2.2 Periodic Tests: Grain flow of die forgings (3.4.4), and tests of stock for forging or rings to determine ability to develop required properties (3.3.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2355 or MAM 2355 and the following:

4.3.1 Surface Imperfections (3.4.1): All die forgings and, when specified, each ring.

4.3.2 Ultrasonic Inspection (3.4.2) and Fluorescent Penetrant Inspection (3.4.3): When specified, all forgings and rings.

4.4 Reports:

4.4.1 The vendor of forgings and rings shall furnish with each shipment a report stating that the product conforms to the chemical composition, tolerances, and NDT inspection when specified and showing the numerical results of tests on each inspection lot to determine conformance to the other acceptance test requirements and to periodic test requirements when performed. This report shall include the purchase order number, inspection lot number, AMS 4127H, size, and quantity.

4.4.2 The vendor of stock for forging or rings shall furnish with each shipment a report stating that the chemical composition of the stock conforms to specified requirements. This report shall include the purchase order number, lot number, AMS 4127H, size, and quantity.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2355 or MAM 2355.