

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

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Superseding AMS 4108D

ALUMINUM ALLOY, HAND FORGINGS
6.2Zn - 2.3Cu - 2.2Mg - 0.1 Zr (7050-T7452)
Solution Heat Treated, Compression Stress-Relieved, and Overaged

UNS A97050

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of hand forgings 8 inches (203 mm) and under in nominal thickness, and of forging stock.

1.2 Application:

These forgings have been used typically for machined structural parts subject to warpage during machining and requiring high strength and resistance to stress-corrosion cracking, 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 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

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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 B 645	Plane Strain Fracture Toughness Testing of Aluminum Alloys
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM E 399	Plane-Strain Fracture Toughness of Metallic Materials
ASTM G 34	Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)

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 American National Standards Institute, Inc., 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
Zinc	5.7	6.7
Copper	2.0	2.6
Magnesium	1.9	2.6
Zirconium	0.08	0.15
Iron	--	0.15
Silicon	--	0.12
Manganese	--	0.10
Titanium	--	0.06
Chromium	--	0.04
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 Forgings: Solution heat treated, stress-relieved by compressing to produce 1 to 5% permanent set, and precipitation heat treated to the T7452 temper. Heat treatment shall be performed 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: Specimens machined from forgings having essentially a rectangular or square cross-section, heat treated in the indicated thickness, shall have the properties shown in Table 2 provided that the as-forged thickness does not exceed 8.0 inches (203 mm). The long-transverse direction for square forgings shall be identified by the vendor.

TABLE 2A - 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	72.0	63.0	9
	Long-Trans.	71.0	61.0	5
Over 2 to 3, incl	Longitudinal	72.0	62.0	9
	Long-Trans.	70.0	60.0	5
	Short-Trans.	67.0	55.0	4
Over 3 to 4, incl	Longitudinal	71.0	61.0	9
	Long-Trans.	70.0	59.0	5
	Short-Trans.	67.0	55.0	4
Over 4 to 5, incl	Longitudinal	70.0	60.0	9
	Long-Trans.	69.0	58.0	4
	Short-Trans.	66.0	54.0	3
Over 5 to 6, incl	Longitudinal	69.0	59.0	9
	Long-Trans.	68.0	56.0	4
	Short-Trans.	66.0	53.0	3
Over 6 to 7, incl	Longitudinal	68.0	58.0	9
	Long-Trans.	67.0	56.0	4
	Short-Trans.	65.0	52.0	3
Over 7 to 8, incl	Longitudinal	67.0	57.0	9
	Long-Trans.	66.0	52.0	4
	Short-Trans.	64.0	50.0	3

TABLE 2B - 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	496	434	8
	Long-Trans.	490	421	5
Over 51 to 76, incl	Longitudinal	496	427	8
	Long-Trans.	483	414	5
	Short-Trans.	462	379	4
Over 76 to 102, incl	Longitudinal	490	421	8
	Long-Trans.	483	407	5
	Short-Trans.	462	379	4
Over 102 to 127, incl	Longitudinal	483	414	8
	Long-Trans.	476	400	4
	Short-Trans,	455	372	3
Over 127 to 152, incl	Longitudinal	476	407	8
	Long-Trans.	469	386	4
	Short-Trans.	455	365	3
Over 152 to 178, incl	Longitudinal	469	400	8
	Long-Trans.	462	386	4
	Short-Trans.	448	359	3
Over 178 to 203, incl	Longitudinal	462	395	8
	Long-Trans.	455	365	4
	Short-Trans.	441	345	3

3.3.1.1.1 Tensile specimens shall be excised from the T/2 and W/2 location at a distance not less than T from the "as heat-treated" edges of the forging.

3.3.1.2 Hardness should be not lower than 135 HB/10/500 or 140 HB/10/1000, or equivalent, but forgings shall not be rejected on the basis of hardness if the tensile property requirements on the nonconforming part or other parts with equivalent lower hardness are met. Hardness determinations shall be performed as a traverse from the T/2 plane to the outer edge of the parent forging.

3.3.1.3 Corrosion Resistance: Resistance to stress-corrosion cracking and to exfoliation-corrosion is acceptable if the requirements of 3.3.1.3.1 and 3.3.1.3.2 are met.

3.3.1.3.1 Electrical Conductivity: Shall be not lower than 38.0% IACS (international Annealed Copper Standard) (22.0 MS/m).

- 3.3.1.3.2 Stress-Corrosion Susceptibility Factor (SCF): Shall be not greater than 32.0 (220), determined by subtracting the electrical conductivity, AA.A% IACS (12 times BB.B MS/m), from the long transverse yield strength, XX.X ksi (YYY MPa).

Examples:

Inch/Pound Units	72.0 ksi - 38.5% IACS = 33.5	Unacceptable
	68.0 ksi - 40.2% IACS = 27.8	Acceptable
SI Units	496 MPa - 12 X 22.3 MS/m = 228.4	Unacceptable
	469 MPa - 12 X 23.3 MS/m = 189.4	Acceptable

- 3.3.1.3.3 Forgings not conforming to 3.3.1.3.1 and 3.3.1.3.2 may be given additional overaging and (R) retested to determine conformance to 3.3.1.1, 3.3.1.3.1, and 3.3.1.3.2.
- 3.3.1.4 Exfoliation-Corrosion Resistance: Specimens cut from forgings shall show a level of exfoliation-corrosion at any plane less than that illustrated by Photograph EB, Figure 2, of ASTM G 34.
- 3.3.1.5 Stress-Corrosion Resistance: Specimens as in 4.3.1 cut from forgings shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction at 35.0 ksi (241 MPa).
- 3.3.1.6 Fracture Toughness: When specified, forgings shall meet the values of K_{IC} shown in Table 3, determined in accordance with ASTM B 645.

TABLE 3A - Fracture Toughness Parameters, Inch/Pound Units

Specimen Orientation	Nominal Thickness Inches	Minimum K_{IC} ksi $\sqrt{\text{inch}}$
L-T	1.500 to 3.000, incl	27
	Over 3.000 to 4.000, incl	26
	Over 4.000 to 8.000, incl	25

TABLE 3B - Fracture Toughness Parameters, SI Units

Specimen Orientation	Nominal Thickness Millimeters	Minimum K_{IC} MPa $\sqrt{\text{m}}$
L-T	38.10 to 76.20, incl	29.7
	Over 76.20 to 101.60, incl	28.6
	Over 101.60 to 203.20, incl	27.5

- 3.3.1.6.1 K_Q values shall meet all requirements of ASTM E 399 for K_{IC} except that invalid K_Q values which are meaningful as defined by ASTM B 645 and which equal or exceed the K_{IC} limit (3.3.1.6) shall be evidence of acceptable fracture toughness.

3.3.2 Forging Stock: 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 as in 3.2.1, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.1. If specimens taken from the stock after heat treatment as in 3.2.1 conform to the requirements of 3.3.1.1, 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 When specified, forgings shall be subjected to ultrasonic inspection in accordance with ASTM B 594 and shall meet the following requirements:

3.4.1.1 Forgings with nominal section thicknesses from 1.000 to 8.000 inches (25.40 to 203.20 mm), inclusive, and weights of each piece up to 600 pounds (272 kg) shall meet ultrasonic Class A.

3.5 Tolerances:

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Forging stock 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 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 as applicable:

4.2.1.1 Composition (3.1).

4.2.1.2 Tensile properties (3.3.1.1), corrosion resistance (3.3.1.3), and, when specified, fracture toughness (3.3.1.6) and ultrasonic soundness (3.4.1) of each inspection lot of forgings.

4.2.1.3 Tolerances (3.5) of forging stock.

4.2.2 Periodic Tests: Hardness (3.3.1.2), exfoliation-corrosion resistance (3.4.1.4), and stress-corrosion resistance (3.3.1.5) and tests of forging stock to demonstrate 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.

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