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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4179A
Superseding AMS 4179

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UNS A97175

ALUMINUM ALLOY HAND FORGINGS
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7175-T73652)
Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of hand forgings and forging stock.

1.2 Application: Primarily for parts requiring a high level of mechanical properties and good resistance to stress-corrosion cracking.

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 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 Drawn
AMS 2350 - Standards and Test Methods
AMS 2375 - Control of Forgings Requiring First Article Approval
AMS 2808 - Identification, Forgings

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

ASTM B342 - Electrical Conductivity by Use of Eddy Currents
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 Alloys
ASTM G47 - Determining Susceptibility to Stress-Corrosion Cracking of High-Strength Aluminum Alloy Products

2.3 U.S. 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:

Ø MIL-H-6088 - Heat Treatment of Aluminum Alloys
MIL-I-8950 - Inspection, Ultrasonic, Wrought Metals, Process for

2.3.3 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 E34, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

Ø

	min	max
Zinc	5.1	6.1
Magnesium	2.1	2.9
Copper	1.2	2.0
Chromium	0.18	0.28
Iron	--	0.20
Silicon	--	0.15
Manganese	--	0.10
Titanium	--	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 Hand Forgings: Solution heat treated, stress relieved by compressing to produce a permanent set of 1 - 5%, and precipitation heat treated. The Ø direction and method of compression shall be as agreed upon by purchaser and vendor. Heat treatments shall be performed using equipment and procedural controls 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:

3.3.1 Hand Forgings:

3.3.1.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM B557 on specimens machined from forgings not over 6 in. (150 mm) in nominal as-forged thickness and having an essentially rectangular or square cross-section not exceeding 156 sq in. (1000 cm^2) in area and heat treated in the indicated thickness.

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 4D %, min
Up to 2, incl	Longitudinal	71,000	61,000	9
	Long Trans.	69,000	58,000	5
Over 2 to 3, incl	Longitudinal	71,000	61,000	9
	Long Trans.	69,000	58,000	5
	Short Trans.	67,000	54,000	4
Over 3 to 4, incl	Longitudinal	68,000	57,000	9
	Long Trans.	67,000	55,000	5
	Short Trans.	65,000	51,000	4
Over 4 to 5, incl	Longitudinal	65,000	54,000	8
	Long Trans.	64,000	52,000	5
	Short Trans.	63,000	49,000	4
Over 5 to 6, incl	Longitudinal	63,000	51,000	8
	Long Trans.	61,000	49,000	5
	Short Trans.	60,000	46,000	4

TABLE I (SI)

Nominal Thickness At Time of Heat Treatment Inches	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D %, min
Up to 50, incl	Longitudinal	490	420	9
	Long Trans.	475	400	5
Over 50 to 75, incl	Longitudinal	490	420	9
	Long Trans.	475	400	5
	Short Trans.	460	370	4
Over 75 to 100, incl	Longitudinal	470	395	9
	Long Trans.	460	380	5
	Short Trans.	450	350	4
Over 100 to 125, incl	Longitudinal	450	370	8
	Long Trans.	440	360	5
	Short Trans.	435	340	4
Over 125 to 150, incl	Longitudinal	435	350	8
	Long Trans.	420	340	5
	Short Trans.	415	315	4

3.3.1.1.1 Ø Tensile property requirements for forgings having configurations or size limitations not covered by 3.3.1.1 shall be as specified on the drawing or as agreed upon by purchaser and vendor.

3.3.1.2 Hardness: Should be not lower than 135 HB/10/500 or 140 HB/10/1000, determined in accordance with ASTM E10, but forgings shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.3.1.3 Conductivity: Shall be as follows, determined in accordance with ASTM B342 on the surface of the sample.

3.3.1.3.1 If the conductivity is 40% IACS (International Annealed Copper Standard) or higher and longitudinal tensile properties meet specified requirements, the forgings are acceptable.

3.3.1.3.2 If the conductivity is 38 - 39.9% IACS, if the longitudinal tensile properties meet specified properties, and if the longitudinal yield strength does not exceed the specified minimum by more than 11,900 psi (82 MPa), the forgings are acceptable.

3.3.1.3.3 If the conductivity is below 40% IACS and longitudinal yield strength exceeds the specified minimum value by more than 11,900 psi (82 MPa), the forgings are suspect.

3.3.1.3.3.1 When forgings are suspect, they may be subjected to additional precipitation heat treatment or a sample of the forgings may be heated for not less than 30 min. at 870°F ± 10 (465°C ± 5) and quenched in cold water. Conductivity shall be measured within 15 min. of quenching. If the difference between this measurement and the original measurement is 6% IACS or more, the forgings are acceptable. If the difference is less than 6% IACS, the forgings shall be reprocessed.

3.3.1.3.4 If the conductivity is below 38% IACS, the forgings are not acceptable and shall be reprocessed, regardless of tensile property level.

3.3.1.4 Stress-Corrosion Resistance: Forgings, 0.750 in. (19 mm) and over in least thickness and processed to meet the requirements of 3.3.1.1 and
Ø 3.3.1.3, shall meet the requirements of ASTM G47 when stressed to 35,000 psi (240 MPa) for forgings 3 in. (75 mm) and under in thickness or to 50% of the specified minimum longitudinal yield strength for forgings over 3 in. (75 mm) and held at constant strain.

3.3.2 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 requirements of 3.3.1.1 and 3.3.1.3. If specimens taken from the stock after heat treatment in the same manner as forgings conform to the requirements of 3.3.1.1 and 3.3.1.3, 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.

3.4 Quality: The product, as received by purchaser, shall be uniform in quality
Ø and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.4.1 Forgings shall be subjected to ultrasonic inspection in accordance with MIL-I-8950 and, unless otherwise specified, shall meet Class A acceptance criteria.

3.5 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 for vendor's tests and shall be responsible for performing all
Ø 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 Ø 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 (3.3.1.1) and conductivity (3.3.1.3) of each lot of forgings.

4.2.1.3 Tolerances (3.5) of forging stock.

4.2.2 Periodic Tests: Tests to determine conformance to the following Ø requirements are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser:

4.2.2.1 Hardness (3.3.1.2) and stress-corrosion resistance (3.3.1.4) of forgings.

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

4.2.3 Preproduction Tests: Tests of forgings to determine conformance to all applicable technical requirements of this specification when AMS 2375 is Ø specified are classified as preproduction tests and shall be performed on the first-article shipment of a forging to a purchaser, when a change in material and/or processing 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 Ø data and, when requested, preproduction forgings 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- Ø furnace load or in a continuous furnace consecutively during an 8-hr period. Frequency and extent of sampling for periodic tests shall be as agreed upon by purchaser and vendor.

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 the 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 6000 lb (2700 kg) or less of material comprising a lot except that not more than one analysis shall be required per piece.

4.3.2 Tensile Properties: Not less than two tensile specimens shall be taken from a forging or forging prolongation representing the lot. One specimen shall be taken in the longitudinal direction and one in the short-transverse direction.