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

AEROSPACE MATERIAL SPECIFICATION

AMS 4147A
Superseding AMS 4147

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UNS A97075

ALUMINUM ALLOY FORGINGS
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr(7075-T7352)

1. SCOPE:

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

1.2 Application: Primarily for parts requiring a combination of good strength and resistance to stress-corrosion cracking, and where good stability is required during machining.

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 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-Base Alloys
ASTM G47 - Determining Susceptibility to Stress-Corrosion Cracking of High-Strength 7XXX Aluminum Alloy Products

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
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

Printed in U.S.A.

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
Zinc	5.1	6.1
Magnesium	2.1	2.9
Copper	1.2	2.0
Chromium	0.18	0.28
Iron	--	0.50
Silicon	--	0.40
Manganese	--	0.30
Zirconium plus Titanium	--	0.25
Titanium	--	0.20
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution heat treated, stress relieved by compression to produce a permanent set of not less than 1% nor more than 5%, and precipitation heat treated. The direction and method of compression shall be as agreed upon by purchaser and vendor. Heat treatments shall be performed in accordance with MIL-H-6088.

3.3 Properties: Forgings shall conform to the following requirements:

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

3.3.1.1 Die Forgings:

3.3.1.1.1 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 of parallel to the forging flow lines shall have the properties shown in Table I.

TABLE I

Nominal Thickness At Time of Heat Treatment Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 4D %, min
Up to 3, incl	66,000	56,000	7
Over 3 to 4, incl	64,000	53,000	7

TABLE I (SI)

Nominal Thickness At Time of Heat Treatment Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D %, min
Up to 76, incl	455	386	7
Over 76 to 102, incl	441	365	7

3.3.1.1.2 Ø Across Grain Flow: Test specimens, machined from forgings not over 4 in. (102 mm) in nominal section thickness at time of heat treatment, with axis of specimens as close to short-transverse direction as possible shall have the properties shown in Table II except as specified in 3.3.1.1.2.1.

TABLE II

Nominal Thickness At Time of Heat Treatment Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset, psi, min	Elongation in 4D %, min
Up to 3, incl	62,000	51,000	3
Over 3 to 4, incl	61,000	49,000	2

TABLE II (SI)

Nominal Thickness At Time of Heat Treatment Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset, MPa, min	Elongation in 4D %, min
Up to 76, incl	427	352	3
Over 76 to 102, incl	421	338	2

3.3.1.1.2.1 The elongation requirements shall not apply to specimens having a gage length diameter less than 0.250 in. (6.35 mm) or located in immediate proximity to an abrupt change in thickness, or located so that any part of the specimen gage length is located within 1/8 in. (3 mm) of the trimmed flash line.

3.3.1.2 Ø Hand Forgings: Test 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 III provided that the as-forged section thickness does not exceed 6 in. (152 mm).

TABLE III

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 3, incl	Longitudinal	66,000	54,000	7
	Long-Trans.	64,000	52,000	4
	Short-Trans.	61,000	50,000	3
Over 3 to 4, incl	Longitudinal	64,000	53,000	7
	Long-Trans.	63,000	50,000	3
	Short-Trans.	60,000	48,000	2
Over 4 to 5, incl	Longitudinal	62,000	51,000	7
	Long-Trans.	61,000	48,000	3
	Short-Trans.	58,000	46,000	2
Over 5 to 6, incl	Longitudinal	61,000	49,000	6
	Long-Trans.	59,000	46,000	3
	Short-Trans.	57,000	44,000	2

TABLE III (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 4D %, min
Up to 76, incl	Longitudinal	455	372	7
	Long-Trans.	441	359	4
	Short-Trans.	421	345	3
Over 76 to 102, incl	Longitudinal	441	365	7
	Long-Trans.	434	345	3
	Short-Trans.	414	331	2
Over 102 to 127, incl	Longitudinal	427	352	7
	Long-Trans.	421	331	3
	Short-Trans.	400	317	2
Over 127 to 152, incl	Longitudinal	421	338	6
	Long-Trans.	407	317	3
	Short-Trans.	393	303	2

3.3.1.3 Special Purpose Forgings: Tensile property requirements for specimens cut from special purpose forgings or from forgings beyond the size and configuration limits of 3.3.1.1 and 3.3.1.2 shall be as specified on the drawing or as agreed upon by purchaser and vendor.

3.3.2 Hardness: Should be as follows, 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:

3.3.2.1 Die Forgings and Hand Forgings Up to 3 in. (76 mm) in Nominal Thickness: Not lower than 125 HB/10/500, 125 HB/14.3/1000, or 130 HB/10/1000.

3.3.2.2 Hand Forgings Over 3 in. (76 mm) in Nominal Thickness: As agreed upon by purchaser and vendor.

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

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

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

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

3.3.3.3.1 When forgings are suspect, they may be reprocessed 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. after quenching. If the difference between this measurement and the original measurement on the forgings is 6% IACS or more, the forgings are acceptable. If the difference is less than 6% IACS, the forgings shall be reprocessed.

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

3.3.4 Stress-Corrosion Resistance: Forgings, 0.750 in. (19.05 mm) in least dimension, processed to meet the requirements of 3.3.1 and 3.3.3 and stressed to 75% of the minimum longitudinal yield strength shall meet the requirements of ASTM G47.

3.3.5 Grain Flow: Shall be as specified on the drawing or as agreed upon by purchaser and vendor.

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

3.4.1 Each forging shall be inspected in accordance with MIL-I-8950 and, unless otherwise specified, shall meet the following requirements of that specification:

3.4.1.1 Die forgings 0.375 to 4.000 in. (9.52 to 101.60 mm), incl, in nominal thickness and weighing not over 300 lb (136 kg) shall meet Class B.

3.4.1.2 Hand forgings 1.000 to 8.000 in. (25.40 to 203.20 mm) in nominal thickness and weighing not more than 600 lb (272 kg) shall meet Class A.

3.4.1.3 Acceptance criteria for forgings exceeding the limits of 3.4.1.1 or 3.4.1.2 shall be as agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of forgings 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 forgings conform to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to composition (3.1), tensile property (3.3.1), hardness (3.3.2), conductivity (3.3.3), and ultrasonic soundness (3.4.1) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests of forgings to determine conformance to stress-corrosion resistance (3.3.4) and grain flow (3.3.5) requirements are classified as periodic tests.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests.

4.2.3.1 For direct U.S. Military procurement, substantiating test 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-furnace load or quenched from 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 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 (2724 kg) or less of material comprising the lot except that not more than one analysis shall be required per piece.

4.3.2 Tensile Properties: