SAE The Engineering Resource For Advancing Mobility

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4131A
Superseding AMS 4131
Issued 12-1-73
Revised 7-1-81

UNS A97075

ALUMINUM ALLOY FORGINGS
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075-T736)
Solution and Precipitation Heat Treated

1. SCOPE:

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

1.2 Application: Primarily for parts requiring a combination of good strength and 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 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 2645 - Fluorescent Penetrant Inspection
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 7XXX 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:

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 analytical methods approved by purchaser:

	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
Titanium	--	0.20
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution and precipitation heat treated in accordance with the procedures and controls of 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 6 in. (152 mm) and under in nominal thickness at time of heat treatment or from prolongations on such forgings, with the axis of specimen in the area of the gage length varying not more than 15 deg from 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 2 in. or 4D %, min
Up to 3, incl	76,000	66,000	7
Over 3 to 4, incl	73,000	63,000	7
Over 4 to 5, incl	70,000	61,000	7
Over 5 to 6, incl	68,000	58,000	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 50 mm or 4D %, min
Up to 76, incl	524	455	7
Over 76 to 102, incl	503	434	7
Over 102 to 127, incl	483	421	7
Over 127 to 152, incl	469	400	7

3.3.1.1.2 Across Grain Flow: Test specimens, machined from forgings 6 in. (152 mm) and under in nominal thickness at time of heat treatment or from prolongations on such forgings, with the axis of specimen in the area of gage length varying not more than 15 deg from perpendicular to the forging flow lines, shall have the properties shown in Table II. If configuration of the forging or prolongation cannot accommodate the transverse specimen described, acceptance of the forging shall be based on testing as in 3.3.1.1.3.

TABLE II

Nominal Thickness At Time Of Heat Treatment Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Up to 3, incl	71,000	62,000	4
Over 3 to 4, incl	70,000	60,000	4
Over 4 to 5, incl	68,000	58,000	4
Over 5 to 6, incl	65,000	55,000	4

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 50 mm or 4D %, min
Up to 76, incl	490	427	4
Over 76 to 102, incl	483	414	4
Over 102 to 127, incl	469	400	4
Over 127 to 152, incl	448	379	4

3.3.1.1.2.1 Elongation requirements shall not apply to specimens having a gage length diameter less than 0.250 in. (6.25 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.

3.3.1.1.3 At Angle to Grain Flow: Test specimens, machined from forgings 6 in. (152 mm) and under in nominal thickness at time of heat treatment or from prolongations on such forgings, with the axis of specimen in the area of gage length varying more than 15 deg from parallel and also more than 15 deg from perpendicular to the forging flow lines, shall have the properties shown in Table II. Such test results shall be identified as neither longitudinal or transverse tensile test results.

3.3.1.2 Hand Forgings: Test specimens, machined from forgings having as essentially square or rectangular cross section, 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 2 in. or 4D %, min
Up to 2, incl	Longitudinal	73,000	63,000	9
	Long Trans.	71,000	60,000	5
Over 2 to 3, incl	Longitudinal	73,000	63,000	9
	Long Trans.	71,000	60,000	5
	Short Trans.	69,000	60,000	4
Over 3 to 4, incl	Longitudinal	71,000	61,000	9
	Long Trans.	70,000	58,000	5
	Short Trans.	68,000	57,000	4
Over 4 to 5, incl	Longitudinal	68,000	57,000	8
	Long Trans.	67,000	56,000	5
	Short Trans.	66,000	55,000	4
Over 5 to 6, incl	Longitudinal	65,000	54,000	8
	Long Trans.	64,000	52,000	5
	Short Trans.	63,000	52,000	4

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 50 mm or 4D %, min
Up to 51, incl	Longitudinal	503	434	9
	Long Trans.	490	414	5
Over 51 to 76, incl	Longitudinal	503	434	9
	Long Trans.	490	414	5
	Short Trans.	476	414	4
Over 76 to 102, incl	Longitudinal	490	421	9
	Long Trans.	483	400	5
	Short Trans.	469	393	4
Over 102 to 127, incl	Longitudinal	469	393	8
	Long Trans.	462	386	5
	Short Trans.	455	379	4
Over 127 to 152, incl	Longitudinal	448	372	8
	Long Trans.	441	359	5
	Short Trans.	434	359	4

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) Incl., in Nominal Thickness: Not lower than 135 HB/10/500, 135 HB/14.3/1000, or 140 HB/10/1000.

3.3.2.2 Die Forgings and Hand Forgings Over 3 In. (76 mm) in Nominal Thickness: As agreed Ø 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: Specimens, cut from forgings 0.750 in. (19 mm) and over in nominal thickness and processed to meet the requirements of 3.3.1 and 3.3.3, stressed in Ø the short transverse direction (perpendicular to grain flow) to 35,000 psi (241 MPa) for forgings 3 in. (76 mm) and under in nominal thickness and to 50% of the longitudinal (parallel to grain flow) yield strength specified in 3.3.1 for forgings over 3 in. (76 mm) in nominal thickness and held at constant strain, 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 Ø vendor.

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

3.4.1 When specified, forgings shall be subjected to ultrasonic inspection in accordance with Ø MIL-I-8950 and, unless otherwise specified, shall meet the following requirements of that specification:

3.4.1.1 Die forgings 0.500 to 4.000 in. (12.70 to 101.60 mm), incl, in nominal thickness and Ø weighing not over 300 lb (136 kg) shall meet Class B.

3.4.1.2 Hand forgings 1.000 to 6.000 in. (25.40 to 152.40 mm), incl, in nominal thickness and Ø 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.

3.4.2 When specified, forgings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645. Standards for acceptance 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 for vendor's tests 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 sample and to perform such confirmatory testing as deemed 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 requirements for composition (3.1), tensile properties (3.3.1), hardness (3.3.2), conductivity (3.3.3), and, when specified, ultrasonic inspection (3.4.1) and fluorescent penetrant inspection (3.4.2) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests of forgings to determine conformance to requirements for stress-corrosion resistance (3.3.4) and grain flow (3.3.5) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification when AMS 2375 is 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 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, 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.

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.

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:

4.3.2.1 Die Forgings: One forging or one forging prolongation heat treated with each lot of forgings.

4.3.2.1.1 In lieu of a prolongation, not less than one tensile specimen with the grain flow and one tensile specimen across the grain flow shall be cut from locations designated on the drawing from a forging representing each lot.