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AEROSPACE MATERIAL SPECIFICATION

AMS 4126A
Superseding AMS 4126

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UNS A97075

ALUMINUM ALLOY FORGINGS
5.6Zn - 2.5Mg - 1.6Cu - 0.23Cr (7075-T6)
Solution and Precipitation Heat Treated

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of die forgings, hand forgings, rolled rings, and stock for forging or rolled rings.

1.2 Application: Primarily for structural applications requiring forgings with high strength in light-to-medium sections. Certain design and processing procedures may cause these products be become susceptible to stress-corrosion cracking; ARP 823 recommends practices to minimize such conditions.

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) and Aerospace Recommended Practices (ARP) 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 2645 - Fluorescent Penetrant Inspection
AMS 2808 - Identification, Forgings

2.1.2 Aerospace Recommended Practices:

ARP 823 - Minimizing Stress Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

REAFFIRMED
10-91.5/95

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

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

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

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: The product shall be supplied in the following condition:

3.2.1 Forgings and Rolled Rings: Solution and precipitation heat treated in accordance with MIL-H-6088.

3.2.2 Stock for Forging or Rolled Rings: As ordered by the forging or rolled ring manufacturer.

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Forgings and Rolled Rings:

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

3.3.1.1.1 Die Forgings:

3.3.1.1.1.1 With Grain Flow: Specimens, machined from forgings 4 in. (100 mm) and under in nominal thickness at time of heat treatment or from prolongations on such forgings, with the axis of specimen in the Ø 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 provided the as-forged thickness is not more than twice the heat treated thickness.

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 1, incl	75,000	64,000	7
Over 1 to 3, incl	74,000	63,000	7
Over 3 to 4, incl	73,000	62,000	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 25, incl	515	440	7
Over 25 to 75, incl	510	435	7
Over 75 to 100, incl	505	425	7

3.3.1.1.1.2 Across Grain Flow: Specimens, machined from forgings 4 in. (100 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 provided tha as-forged thickness is not more than twice the heat treated thickness. If configuration of the forging or prolongation cannot accommodate the transverse specimen described, acceptance of the forging shall be based on testing as in 3.3.1.1.1.3.

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 2, incl	71,000	61,000	3
Over 2 to 3, incl	70,000	60,000	3
Over 3 to 4, incl	70,000	60,000	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 50 mm or 4D %, min
Up to 50, incl	490	420	3
Over 50 to 75, incl	485	415	3
Over 75 to 100, incl	485	415	2

3.3.1.1.1.2.1 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.

3.3.1.1.1.3 At Angle to Grain Flow: Specimens, machined from forgings 4 in, (100 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 provided the as-forged thickness is not more than twice the heat treated thickness. Such test results shall be identified as neither longitudinal nor transverse tensile properties.

3.3.1.1.2 Ø Hand Forgings: Specimens, machined form forgings having an essentially square or rectangular cross-section, shall have the properties shown in Table III provided that the as-forged thickness does not exceed 6 in. (150 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	74,000	63,000	9
	Long Trans.	73,000	61,000	4
Over 2 to 3, incl	Longitudial	73,000	61,000	9
	Long Trans.	71,000	59,000	4
	Short Trans.	69,000	58,000	3
Over 3 to 4, incl	Longitudinal	71,000	60,000	8
	Long Trans.	70,000	58,000	3
	Short Trans.	68,000	57,000	2
Over 4 to 5, incl	Longitudinal	69,000	58,000	7
	Long Trans.	68,000	56,000	3
	Short Trans.	66,000	56,000	2
Over 5 to 6, incl	Longitudinal	68,000	56,000	6
	Long Trans.	66,000	55,000	3
	Short Trans.	65,000	55,000	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 50 mm or 4D %, min
Up to 50, incl	Longitudinal	510	435	9
	Long Trans.	505	420	4
Over 50 to 75, incl	Longitudinal	505	420	9
	Long Trans.	490	405	4
	Short Trans.	475	400	3
Over 75 to 100, incl	Longitudinal	490	415	8
	Long Trans.	485	400	3
	Short Trans.	470	395	2
Over 100 to 125, incl	Longitudinal	475	400	7
	Long Trans.	470	385	3
	Short Trans.	455	385	2
Over 125 to 150, incl	Longitudinal	470	385	6
	Long Trans.	455	380	3
	Short Trans.	450	380	2

3.3.1.1.3 Rolled Rings: Specimens, machined from rings with axis of specimen approximately tangential to the ring OD (axis parallel to direction of rolling) or with axis approximately parallel to the axis of the ring (transverse to direction of rolling) shall have the properties shown in Table IV.

TABLE IV

Nominal Wall 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	Tangential	73,000	62,000	7
	Axial	72,000	61,000	3
Over 2 to 3.5, incl	Tangential	71,000	60,000	6
	Axial	70,000	59,000	3

TABLE IV(SI)

Nominal Wall 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 50, incl	Tangential	505	425	7
	Axial	495	420	3
Over 50 to 90, incl	Tangential	490	415	6
	Axial	485	405	3

3.3.1.1.4 Special Purpose Forgings: Tensile property requirements for specimens cut from special purpose forgings or from forgings beyond the size and configuration limits of 3.3.1.1.1, 3.3.1.1.2, and 3.3.1.1.3 shall be as specified on the drawing or as agreed upon by purchaser and vendor.

3.3.1.1.5 Test Specimens: Specimens machined from separately-forged coupons or from forging stock representing the forgings and, in either case, heat treated with the forgings shall have the following tensile properties:

Tensile Strength, min	75,000 psi (515 MPa)
Yield Strength at 0.2% Offset, min	64,000 psi (440 MPa)
Elongation in 4D, min	10%

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 the forgings or rolled rings shall not be rejected on the basis of hardness if the applicable tensile property requirements are met.

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

3.3.2 Stock for Forging or Rolled Rings: When a sample of stock is forged to a test coupon and heat treated in the same manner as forgings and rolled rings, specimens taken from the heat treated coupon shall conform to the Ø requirements of 3.3.1.1.5 and 3.3.1.2. If specimens taken from the stock after heat treatment in the same manner as forgings and rolled rings conform to the requirements of 3.3.1.1.5 and 3.3.1.2, 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 When specified, forgings and rolled rings shall be subjected to ultrasonic Ø inspection in accordance with MIL-I-8950 and, unless otherwise specified, shall meet the following requirements of that specification:

3.4.1.1 Die forgings and rolled rings 0.500 to 4.000 in. (12.50 to 100.00 mm), Ø incl, in nominal thickness and weighing not over 300 lb (135 kg) shall meet Class B.

3.4.1.2 Hand forgings 1.000 to 6.000 in. (25.00 to 150.00 mm), incl, in nominal Ø thickness and weighing not more than 600 lb (270 kg) shall meet Class A.

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

3.4.2 When specified, forgings and rolled rings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Tolerances: Unless otherwise specified, tolerances for forging stock shall be in accordance with all applicable requirements of AMS 2201.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all Ø 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 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 of forgings and rolled rings to determine Ø conformance to requirements for tensile properties (3.3.1.1), hardness (3.3.1.2), and, when specified, ultrasonic and fluorescent penetrant inspection (3.4.1 and 3.4.2) and of stock for forging or rolled rings to determine conformance to requirements for composition (3.1) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests of forgings to determine conformance to Ø requirements for grain flow (3.3.1.3) and tests of stock for forging or rolled rings to determine ability to develop specified properties (3.3.2) 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 of forgings and rolled rings to determine Ø conformance to the applicable 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 or rolled ring 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 and rolled rings, Ø substantiating test data and, when requested, preproduction forgings or rolled rings 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 or rolled rings Ø 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. Complete ingot analysis records shall be available to the purchaser.

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 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: At least one separately-forged coupon or one forging prolongation heat treated with each lot of forgings.

4.3.2.1.1 In lieu of a prolongation or separately-forged coupon, at least one Ø tensile specimen with the grain flow and one tensile specimen across the grain flow shall be cut, from the locations designated on the drawing or as specified by purchaser, from a forging representing each lot.

4.3.2.2 Hand Forgings: At least two tensile specimens shall be taken from a forging or forging prolongation representing the lot. One specimen shall be taken in the long-transverse direction and the other in the short-transverse direction. Tests need not be made in the longitudinal direction unless specifically required by purchaser.