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

AEROSPACE MATERIAL SPECIFICATION

AMS 4101

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Revised

ALUMINUM ALLOY PLATE
4.4Cu - 1.5Mg - 0.60Mn (2124-T851)

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of plate.

1.2 Application: Primarily for parts requiring a high level of mechanical properties up to 300° F (150° C). Certain design and fabrication procedures may cause this material to be 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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2202 - Tolerances, Aluminum-Base and Magnesium-Base Alloy Sheet and Plate
AMS 2350 - Standards and Test Methods
AMS 2355 - Quality Assurance Sampling and Testing of Aluminum-Base and Magnesium-Base Alloys, Wrought Products (Except Forgings and Forging Stock) and Flash Welded Rings

2.1.2 Aerospace Recommended Practices:

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

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

ASTM E399 - Plane-Strain Fracture Toughness of Metallic Materials
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 19102.

2.3.1 Military Specifications:

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

2.3.2 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 in accordance with AMS 2355:

	min	max
Copper	3.8	4.9
Magnesium	1.2	1.8
Manganese	0.30	0.9
Iron	--	0.30
Zinc	--	0.25
Silicon	--	0.20
Zirconium + Titanium	--	0.20
Titanium	--	0.15
Chromium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution heat-treated, stretched to produce a nominal permanent set of 2% but not less than 1-1/2% nor more than 3%, and precipitation heat-treated. Heat treatments shall be performed in accordance with MIL-H-6088 as applicable to production of 2024-T851 plate or equivalent.

3.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties: Plate shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with AMS 2355.

TABLE I

Nominal Thickness Inches	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
1-1/2 to 2, incl	Longitudinal	66,000	57,000	6
	Long Trans.	66,000	57,000	5
	Short Trans.	64,000	55,000	1.5
Over 2 to 3, incl	Longitudinal	65,000	57,000	6
	Long Trans.	65,000	57,000	4
	Short Trans.	63,000	55,000	1.5
Over 3 to 4, incl	Longitudinal	65,000	56,000	5
	Long Trans.	65,000	56,000	4
	Short Trans.	62,000	54,000	1.5
Over 4 to 5, incl	Longitudinal	64,000	55,000	5
	Long Trans.	64,000	55,000	4
	Short Trans.	61,000	53,000	1.5
Over 5 to 6, incl	Longitudinal	63 000	54,000	5
	Long Trans.	63 000	54,000	4
	Short Trans.	58 000	51,000	1.5

TABLE I (SI)

Nominal Thickness Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
38 to 51, incl	Longitudinal	455	393	6
	Long Trans.	455	393	5
	Short Trans.	441	379	1.5
Over 51 to 76, incl	Longitudinal	448	393	6
	Long Trans.	448	393	4
	Short Trans.	434	379	1.5
Over 76 to 102, incl	Longitudinal	448	386	5
	Long Trans.	448	386	4
	Short Trans.	427	372	1.5
Over 102 to 127, incl	Longitudinal	441	379	5
	Long Trans.	441	379	4
	Short Trans.	421	365	1.5
Over 127 to 152, incl	Longitudinal	434	372	5
	Long Trans.	434	372	4
	Short Trans.	400	352	1.5

3.3.1.1 Tensile property requirements for plate under 1-1/2 in. (38 mm) or over 6 in. (152 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.2 Stress-Corrosion Resistance: When specified, plate 1.5 in. (38 mm) to 6 in. (152 mm), incl. in nominal thickness, stressed to 50% of the specified minimum long-transverse yield strength, shall meet the requirements of ASTM G47.

3.3.3 Ultrasonic Soundness: Unless otherwise specified, each plate shall be inspected in accordance with MIL-I-8950 and shall meet the following requirements:

3.3.3.1 Plates weighing 2000 lb (908 kg) or less shall meet the requirements for ultrasonic class as follows:

Nominal Thickness		Ultrasonic Class
Inches	(Millimetres)	
1-1/2 to 3, incl	(38 to 76, incl)	A
Over 3 to 4-1/2, incl	(Over 76 to 114, incl)	B

3.3.3.2 The ultrasonic class for plates weighing over 2000 lb (908 kg) or over 4-1/2 in. (114 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.4 Fracture Toughness: When specified, plate having a nominal thickness of 1-1/2 - 6 in. (38 - 152 mm), incl, shall meet the following values of K_{Ic}, determined in accordance with ASTM E399. The required test directions shall be as specified by the purchaser.

Test Direction	K_{Ic}, min	
	Ksi$\sqrt{\text{in.}}$	(MPa$\sqrt{\text{m}}$)
L - T	24	(26.4)
T - L	20	(22.0)
S - L	18	(19.8)

3.3.4.1 All K_Q values obtained shall meet all validity requirements of ASTM E399 for K_{Ic} except that K_Q values which are invalid for the following reasons shall be considered meaningful and, if equal to or greater than the appropriate values shown above, shall be evidence of acceptable fracture toughness:

3.3.4.1.1 Insufficient specimen thickness

3.3.4.1.2 Excessive plasticity as indicated by the ratio of P_{max}/P_Q exceeding 1.1

3.3.4.1.3 Stress level during last step of fatigue cracking exceeding the maximum level of 0.6 K_Q by no more than 0.1 K_Q

3.3.4.1.4 The difference between any two of the three center dimensions required for measuring fatigue crack front curvature may vary as much as 10%.

3.4 Quality: Plate, 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 plate.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2202.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of plate 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 plate conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests.

4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material 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 in accordance with AMS 2355 and the following; an inspection lot shall be all plate of the same alloy, temper, section, and size traceable to a heat treatment lot and submitted for vendor's inspection at one time.

4.3.1 Specimens for tensile tests shall be taken parallel to each applicable grain flow direction specified in Table I.

4.3.2 Specimens for stress-corrosion testing shall be taken parallel to the short transverse grain direction from the center width of at least one plate from each lot.

4.3.3 Specimens for fracture-toughness testing shall, unless otherwise specified, be taken from the center width of at least one plate in each lot for each test direction specified.

4.4 Approval:

4.4.1 Sample plate shall be approved by purchaser before plate for production use is supplied, unless such approval be waived. Results of tests on production plate shall be essentially equivalent to those on the approved sample plate.