

ALUMINUM ALLOY PLATE
4.4Cu - 1.5Mg - 0.60Mn (2124-T8151)
Solution Heat Treated, Stress Relieved and Precipitation Heat Treated
UNS A92124

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of plate 1.5 inch (38 mm) and over in nominal thickness.

1.2 Application: Primarily for parts requiring a high level of mechanical properties up to 300°F (149°C). Certain design and fabrication procedures may cause the plate to 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 and Aerospace Recommended Practices 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 2202 - Tolerances, Aluminum Alloy and Magnesium Alloy Sheet and Plate

MAM 2202 - Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Sheet and Plate

AMS 2350 - Standards and Test Methods

AMS 2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings

MAM 2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings, Metric (SI) Units

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2.1.2 Aerospace Recommended Practices:

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

ARP 1704 - Short-Bar Fracture Toughness of Metallic Materials, Determination of

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

ASTM B594 - Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications

ASTM B660 - Packaging/Packing of Aluminum and Magnesium Products

ASTM E399 - Plane-Strain Fracture Toughness of Metallic Materials

ASTM E602 - Sharp-Notch Tension Testing with Cylindrical Specimens

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined in accordance with AMS 2355 or MAM 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
Titanium	--	0.15
Chromium	--	0.10
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition: Solution heat treated, stress relieved by stretching 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 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 or MAM 2355.

TABLE I

Nominal Thickness Inches	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, minimum	Elongation in 2 in. or 4D %, minimum
1-1/2 to 2, incl	Longitudinal	68,000	62,000	8
	Long-Transverse	68,000	61,000	7
	Short-Transverse	65,000	57,000	2
Over 2 to 3, incl	Longitudinal	67,000	60,000	8
	Long-Transverse	67,000	60,000	7
	Short-Transverse	64,000	57,000	2
Over 3 to 4, incl	Longitudinal	67,000	59,000	7
	Long-Transverse	67,000	59,000	6
	Short-Transverse	64,000	57,000	2
Over 4 to 5, incl	Longitudinal	66,000	58,000	6
	Long-Transverse	66,000	58,000	6
	Short-Transverse	63,000	55,000	2
Over 5 to 6, incl	Longitudinal	65,000	57,000	6
	Long-Transverse	65,000	56,000	5
	Short-Transverse	62,000	54,000	2

TABLE I (SI)

Nominal Thickness Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min
38 to 51, incl	Longitudinal	469	427	8
	Long-Transverse	469	421	7
	Short-Transverse	448	393	2
Over 51 to 76, incl	Longitudinal	462	414	8
	Long-Transverse	462	414	7
	Short-Transverse	441	393	2
Over 76 to 102, incl	Longitudinal	462	407	7
	Long-Transverse	462	407	6
	Short-Transverse	441	393	2
Over 102 to 127, incl	Longitudinal	455	400	6
	Long-Transverse	455	400	6
	Short-Transverse	434	379	2
Over 127 to 152, incl	Longitudinal	448	393	6
	Long-Transverse	448	386	5
	Short-Transverse	427	372	2

- 3.3.1.1 Tensile property requirements for plate under 1-1/2 inches (38 mm) or over 6 inches (152 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.
- 3.3.2 Stress-Corrosion Resistance: When specified, specimens as in 4.5.2 from plate 1.5 - 6 inches (38 - 152 mm), incl, in nominal thickness shall show no evidence of stress-corrosion cracking when stressed to 50% of the specified minimum long-transverse yield strength.
- 3.3.3 Fracture Toughness: Except as permitted by 3.3.4, plate shall meet the following values of K_{IC} , determined in accordance with ASTM E399. The required specimen orientation shall be as specified by purchaser.

TABLE II

Nominal Thickness Inches	K_{IC} ksi Inch		
	L-T	T-L	S-L
1.500 to 2.000, incl	26	23	19
Over 2.000 to 4.000, incl	26	22	20
Over 4.000 to 6.000, incl	25	21	21

TABLE II (SI)

Nominal Thickness Millimetres	K_{IC} MPa m		
	L-T	T-L	S-L
38.10 to 50.80, incl	28.6	25.3	20.9
Over 50.80 to 101.60, incl	28.6	24.2	22.0
Over 101.60 to 152.40, incl	27.5	23.1	23.1

- 3.3.4 Indicator Tests: The producer may guarantee that plate meets the fracture toughness (K_{IC}) requirements based on correlation with notch tensile strength/tensile yield strength (NTS/TYS) ratio, determined in accordance with 3.3.4.1 or correlation with the short-bar fracture toughness results, determined in accordance with 3.3.4.2 in lieu of determining fracture toughness (3.3.3) provided correlation has been established between the two tests for the plate.
- 3.3.4.1 NTS/TYS Ratio: Notch tensile strength shall be determined in accordance with ASTM E602 on specimens taken in both the longitudinal and long-transverse directions. The values for each direction shall be divided by the tensile yield strength, determined for the same direction, to obtain the NTS/TYS ratios.
- 3.3.4.2 Short-Bar Test: Shall be not lower than the values for K_{IC} specified in Table II, determined in accordance with ARP 1704.

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

3.4.1 Each plate shall be ultrasonically inspected in accordance with ASTM B594 and shall meet the requirements for Class A.

3.5 Tolerances: Shall conform to all applicable requirements of AMS 2202 or MAM 2202.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of plate 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 any confirmatory testing deemed necessary to ensure that the plate conforms 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), long-transverse tensile properties and, when specified, longitudinal, short-transverse, or both, tensile properties (3.3.1), fracture toughness (3.3.3), ultrasonic soundness (3.4.1), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for stress-corrosion resistance (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.

4.3 Sampling: Shall be in accordance with AMS 2355 or MAM 2355 and the following:

4.3.1 Tensile specimens shall be taken with the axis of specimens in the long-transverse direction and, when specified, in the longitudinal, short-transverse, or both directions.

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 be taken from the center width of at least one plate in each lot for each test direction specified.

4.4 Reports:

4.4.1 The vendor of plate shall furnish with each shipment a report stating that the plate conforms to the chemical composition and showing the results of tests on each inspection lot to determine conformance to the other technical requirements of this specification. This report shall include the purchase order number, inspection lot number, AMS 4221, size, and quantity.