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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4202B

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Superseding AMS 4202A

ALUMINUM ALLOY PLATE
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T7351)
Solution Heat Treated, Stress Relieved by Stretching, and Precipitation Heat Treated

UNS A97475

1. SCOPE:

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

1.2 Application: Primarily for structural applications requiring material with high strength and resistance to stress-corrosion, moderate fatigue strength, and high fracture toughness.

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

2.1.2 Aerospace Recommended Practices:

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

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 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

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 or MAM 2355:

	min	max
Zinc	5.2	6.2
Magnesium	1.9	2.6
Copper	1.2	1.9
Chromium	0.18	0.25
Iron	--	0.12
Silicon	--	0.10
Manganese	--	0.06
Titanium	--	0.06
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; furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-6088.

3.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties: Plate shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355 except that fracture toughness and notch tensile testing or short-bar fracture toughness shall be performed as in 3.3.2.2, 3.3.3.1 or 3.3.4, respectively.

3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.2.
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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
0.250 to 1.500, excl	Longitudinal	71,000	60,000	10
	Long Transverse	71,000	60,000	9
1.500	Longitudinal	71,000	60,000	10
	Long Transverse	71,000	60,000	9
	Short Transverse	67,000	56,000	4
Over 1.500 to 2.000, incl	Longitudinal	70,000	58,000	10
	Long Transverse	70,000	58,000	8
	Short Transverse	66,000	54,000	4
Over 2.000 to 2.500, incl	Longitudinal	69,000	57,000	10
	Long Transverse	69,000	57,000	8
	Short Transverse	65,000	53,000	4
Over 2.500 to 3.000, incl	Longitudinal	68,000	56,000	10
	Long Transverse	68,000	56,000	8
	Short Transverse	65,000	53,000	3
Over 3.000 to 3.500, incl	Longitudinal	65,000	53,000	10
	Long Transverse	65,000	53,000	8
	Short Transverse	64,000	51,000	3
Over 3.500 to 4.000, incl	Longitudinal	64,000	52,000	9
	Long Transverse	64,000	52,000	7
	Short Transverse	63,000	50,000	3

TABLE I (SI)

Nominal Thickness Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation % min in 50 mm	Elongation % min in 62.5 mm or 5D
Over 6.25 to 12.50, incl	Longitudinal	490	415	10	-
	Long Transverse	490	415	9	-
Over 12.5 to 37.50, incl	Longitudinal	490	515	-	9
	Long Transverse	490	515	-	8
37.50	Longitudinal	490	415	-	9
	Long Transverse	490	415	-	8
	Short Transverse	460	385	-	4
Over 37.50 to 50.00, incl	Longitudinal	480	400	-	9
	Long Transverse	480	400	-	7
	Short Transverse	455	370	-	4
Over 50.00 to 62.50, incl	Longitudinal	475	395	-	9
	Long Transverse	475	395	-	7
	Short Transverse	450	365	-	4
Over 62.50 to 75.00, incl	Longitudinal	470	385	-	9
	Long Transverse	470	385	-	7
	Short Transverse	450	365	-	3
Over 75.00 to 87.50, incl	Longitudinal	450	365	-	9
	Long Transverse	450	365	-	7
	Short Transverse	440	350	-	3
Over 87.50 to 100.00, incl	Longitudinal	440	360	-	8
	Long Transverse	440	360	-	6
	Short Transverse	435	345	-	3

3.3.1.1 Short-transverse tensile property requirements apply only to plate 1.500 in. (37.50 mm) and over in nominal thickness.

3.3.1.2 Tensile property requirements for plate over 4.000 in. (100.00 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.2 Fracture Toughness: Plane-strain fracture toughness (K_{Ic}) for the L-T and T-L specimen orientations (See 8.3), determined in accordance with 3.3.2.2, shall be not lower than the values specified in Table II. When specified, plate having nominal thickness of 2.750 to 4.000 in. (68.75 to 100.00 mm), incl, shall meet the K_{Ic} value in Table II for the S-L specimen orientation.

TABLE II

Nominal Thickness		Specimen Orientation (See 8.3)	K_{Ic}	
Inches	Millimetres		Ksi$\sqrt{in.}$	MPa$\sqrt{m}$
Over 0.749 to 1.249, incl	Over 18.75 to 31.25, incl	L-T	38	42
Over 0.749 to 1.249, incl	Over 18.75 to 31.25, incl	T-L	32	35
Over 1.249 to 4.000, incl	Over 31.25 to 100.00, incl	L-T	40	44
Over 1.249 to 4.000, incl	Over 31.25 to 100.00, incl	T-L	33	36
2.750 to 4.000, incl	68.75 to 100.00, incl	S-L	25	27

3.3.2.1 Plane-strain fracture toughness (K_{Ic}) values for plate 0.250 to 0.749 in. (6.25 to 18.75 mm), incl, and for plate over 4.000 in. (100.00/mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.2.2 Fracture toughness shall be determined in accordance with ASTM E399. The L-T and T-L specimens of the standard proportions shown in ASTM E399 shall have crack length of not less than 1.50 in. (37.5 mm), i.e. W = 3.00 in. (75.0 mm), and be full thickness. All K_Q values shall meet all validity requirements of ASTM E399 for K_{Ic} except that invalid K_Q values which are meaningful as defined by ASTM B645 and are equal to, or greater than, the appropriate value in Table II shall be evidence of acceptable fracture toughness.

3.3.3 Notch Tensile Strength/Tensile Yield Strength (NTS/TYS) Ratio: 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 3.3.3.1 or correlation with the short-bar fracture toughness results determined in accordance with 3.3.4 in lieu of determining fracture toughness (3.3.2) provided that correlation has been established between the two tests.

3.3.3.1 NTS/TYS Ratio: For plate over 0.749 to 4.000 in. (18.75 to 100.00 mm), incl, in nominal thickness, 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 NTS/TYS ratios.

3.3.4 Short-Bar Fracture Toughness: Shall be not lower than the values for K_{Ic} specified in Table II, determined in accordance with ARP 1704 on specimens from plate 1.000 to 4.000 in. (25.00 to 100.00 mm), incl, in nominal thickness.

3.3.5 Corrosion Resistance: Shall conform to 3.3.5.1 and 3.3.5.2.

3.3.5.1 Indicator Test:

3.3.5.1.1 If the conductivity is 40% IACS (International Annealed Copper Standard) (23 MS/m) or higher determined on the surface of the tensile specimens and tensile properties meet specified requirements, the plate is acceptable.

3.3.5.1.2 If the conductivity is below 40% IACS, the plate shall be reprocessed.

3.3.5.2 Alternate-Immersion Test: Specimens cut from plate 0.750 in. (18.75 mm) and over in nominal thickness, shall show no evidence of stress-corrosion cracking, when stressed to 40,000 psi (275 MPa).

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 When specified, each plate 0.500 to 4.000 (12.50 to 100.00 mm) in nominal thickness shall be ultrasonically inspected in accordance with ASTM B594 and shall meet the following requirements:

3.4.1.1 Plates weighing 2000 lb (900 kg) or less shall meet the requirements for ultrasonic class shown below:

Nominal Thickness		Ultrasonic Class
Inches	Millimetres	
0.500 to 1.499, incl	12.50 to 37.50, incl	B
Over 1.400 to 3.000, incl	Over 37.50 to 75.00, incl	A
Over 3.000 to 4.000, incl	Over 75.00 to 100.00, incl	B

3.4.1.2 The ultrasonic class for plates weighing over 2000 lb (900 kg) shall be as agreed upon by purchaser and vendor.

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 4.4. 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), tensile properties (3.3.1), fracture toughness (3.3.2), notch tensile strength/tensile yield strength ratio (3.3.3), or short-bar fracture toughness (3.3.4), corrosion indicator test (3.3.5.1), ultrasonic soundness (3.4.1) when specified, and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot except that fracture toughness need not be determined if the notch tensile strength/tensile yield strength ratio or the short-bar fracture toughness indicates that the established correlation is met.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for alternate immersion test (3.3.5.2) 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; an inspection lot for tensile properties, fracture toughness, notch tensile strength/tensile yield strength ratio, short-bar fracture toughness, and corrosion resistance shall be all plate traceable to a heat treat lot and presented for vendor's inspection at one time.

4.3.1 Specimens for conductivity testing shall be the tensile test samples.

4.4 Reports:

4.4.2 The vendor of plate shall furnish with each shipment a report stating that the plate conforms to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 4202B, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4202B, contractor or other direct supplier of plate, part number, and quantity. When plate for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of plate to determine conformance to the requirements of this specification and shall include in the report either a statement that the plate conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2355 or MAM 2355.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each plate shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4202B, inspection lot number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be legible, shall be applied using a suitable marking fluid, and shall be sufficiently stable to withstand normal handling. The markings shall have no deleterious effect on the plate or its performance.

5.1.1 Plate Under 6 In. (150 mm) Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (900 mm). The inspection lot number may appear in the row marking or may appear at only one location on each plate.