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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4202A
Superseding AMS 4202

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ALUMINUM ALLOY PLATE
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T7351)

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 (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

2.1.1 Aerospace Recommended Practices:

ARP 1704 - 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 B645 - Plane-Strain Fracture Toughness Testing of Aluminum Alloys
ASTM E399 - Plane-Strain Fracture Toughness of Metallic Materials
ASTM E602 - Sharp-Notch Tension Testing with Cylindrical Specimens
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 Military Specifications:

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

2.4 ANSI Publications: Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined in accordance with AMS 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.

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 Ø AMS 2355 except that fracture toughness and/or 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.

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	68,000	57,000	10
	Long Transverse	68,000	57,000	9
1.500	Longitudinal	68,000	57,000	10
	Long Transverse	68,000	57,000	9
	Short Transverse	64,000	53,000	4
Over 1.500 to 2.000, incl	Longitudinal	67,000	55,000	10
	Long Transverse	67,000	55,000	8
	Short Transverse	64,000	52,000	4
Over 2.000 to 2.500, incl	Longitudinal	66,000	54,000	10
	Long Transverse	66,000	54,000	8
	Short Transverse	64,000	52,000	4
Over 2.500 to 3.000, incl	Longitudinal	65,000	53,000	10
	Long Transverse	65,000	53,000	8
	Short Transverse	62,000	50,000	3
Over 3.000 to 3.500, incl	Longitudinal	63,000	51,000	10
	Long Transverse	63,000	51,000	8
	Short Transverse	61,000	48,000	3
Over 3.500 to 4.000, incl	Longitudinal	61,000	48,000	9
	Long Transverse	61,000	48,000	7
	Short Transverse	59,000	46,000	3

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
6.35 to 38.10, excl	Longitudinal	469	393	10
	Long Transverse	469	393	9
38.10	Longitudinal	469	393	10
	Long Transverse	469	393	9
	Short Transverse	441	365	4
Over 38.10 to 50.80, incl	Longitudinal	462	379	10
	Long Transverse	462	379	8
	Short Transverse	441	359	4
Over 50.80 to 63.50, incl	Longitudinal	455	372	10
	Long Transverse	455	372	8
	Short Transverse	441	359	4
Over 63.50 to 76.20, incl	Longitudinal	448	365	10
	Long Transverse	448	365	8
	Short Transverse	427	345	3
Over 76.20 to 88.90, incl	Longitudinal	434	352	10
	Long Transverse	434	352	8
	Short Transverse	421	331	3
Over 88.90 to 101.60, incl	Longitudinal	421	331	9
	Long Transverse	421	331	7
	Short Transverse	407	317	3

3.3.1.1 Short-transverse tensile property requirements apply only to plate 1.500 in. (38.10 mm) and over in nominal thickness.

3.3.1.2 Tensile property requirements for plate over 4.000 in. (101.60 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. (69.85 to 101.60 mm), incl, shall meet the K_{Ic} value in Table II for the S-L specimen orientation.

TABLE II

Nominal Thickness Inches	Nominal Thickness (Millimetres)	Specimen Orientation (See 8.3)	K_{Ic} ksi$\sqrt{in.}$	K_{Ic} (MPa$\sqrt{m}$)
Over 0.749 to 4.000, incl	(Over 19.02 to 101.60, incl)	L-T	38	(42)
Over 0.749 to 4.000, incl	(Over 19.02 to 101.60, incl)	T-L	32	(35)
2.750 to 4.000, incl	(69.85 to 101.60, incl)	S-L	25	(27)

3.3.2.1 Plane-strain fracture toughness (K_{Ic}) values for plate 0.250 to 0.749 in. (6.35 to 19.02 mm), incl, and for plate over 4.000 in. (101.60 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 Ø not less than 1.50 in. (38 mm), i.e. W = 3.00 in. (76.2 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: Unless otherwise specified, the producer may guarantee that plate meets the fracture toughness (K_{Ic}) requirements Ø 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 he has established correlation between the two tests for his plate.

3.3.3.1 NTS/TYS Ratio: For plate over 0.749 to 4.000 in. (19.02 to 101.60 mm), incl, in nominal thickness, notch tensile strength shall be determined in accordance with ASTM E602 on Ø 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 Ø Table II, determined in accordance with ARP 1704 on specimens from plate 1.000 to 4.000 in. (25.40 to 101.60 mm), incl, in nominal thickness.

Ø 3.3.5 Conductivity: Shall be as follows, determined on the surface of the tensile test specimens:

3.3.5.1 If the conductivity is 40% IACS (International Annealed Copper Standard) or higher and Ø tensile properties meet specified requirements, the plate is acceptable.

3.3.5.2 If the conductivity is 38 - 39.9% IACS, incl, if the tensile properties meet specified re- Ø quirements, and if the longitudinal yield strength does not exceed the specified minimum by more than 11,900 psi (82 MPa), the plate is acceptable.

3.3.5.3 Plate with conductivity lower than 40% is acceptable provided the stress-corrosion proper- Ø ties of 3.3.6 are met.

3.3.5.4 If the conductivity is below 40% IACS and the longitudinal yield strength exceeds the Ø specified minimum value by more than 11,900 psi (82 MPa), the plate is suspect.

3.3.5.4.1 When plate is suspect, it may be reprocessed or a sample of the plate may be heated for Ø not less than 30 min. at 870°F ± 10 (465°C ± 5) and quenched in cold water. Conductivity shall be measured within 15 min. of quenching. If the difference between this measurement and the original measurement on the plate is 6% IACS or more, the plate is acceptable. If the difference is less than 6% IACS, the plate shall be reprocessed.

3.3.5.5 If the conductivity is below 38% IACS, the plate is not acceptable and shall be reprocessed, Ø regardless of mechanical property level.

3.3.6 Stress-Corrosion Resistance: Plate 0.750 in. (19 mm) and over in nominal thickness, stressed in accordance with ASTM G47 to 75% of the specified minimum long-transverse yield strength, shall meet the requirements of ASTM G47.

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.

3.4.1 When specified, each plate shall be ultrasonically inspected in accordance with MIL-I-8950 and shall meet the following requirements:

3.4.1.1 Unless otherwise specified, plates weighing 2,000 lb (908 kg) or less shall meet the requirements for ultrasonic class shown below:

Nominal Thickness		Ultrasonic Class
Inches	(Millimetres)	
0.500 to 1.499, incl	(12.70 to 38.07, incl)	B
Over 1.499 to 3.000, incl	(Over 38.07 to 76.20, incl)	A
Over 3.000 to 4.000, incl	(Over 76.20 to 101.60, incl)	B

3.4.1.2 The ultrasonic class for plates weighing over 2,000 lb (908 kg) shall be as agreed upon by purchaser and vendor.

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 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), conductivity (3.3.5), ultrasonic soundness (3.4.1) when specified, and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot of plate 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 stress-corrosion resistance (3.3.6) 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 and the following; an inspection lot for tensile properties, fracture toughness, notch tensile strength/tensile yield strength ratio, short-bar fracture toughness, and conductivity 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:

4.4.1 The vendor of plate shall furnish with each shipment three copies of 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, AMS 4202A, size, and quantity.