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

AEROSPACE MATERIAL SPECIFICATION

AMS 4202

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Revised

UNS A97475

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

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) 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

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

ASTM E338 - Sharp-Notch Tension Testing of High-Strength Sheet Materials
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 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 AMS 2355 except that fracture toughness and notch tensile testing shall be performed as in 3.3.2.2 and 3.3.3.1, 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	Longitudianl	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, 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		Specimen Orientation (See 8.2)	K_{Ic}	
Inches	(Millimetres)		$ksi\sqrt{in.}$	$(MPa\sqrt{m})$
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 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 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 applicable values in Table III, shall be evidence of acceptable fracture toughness:

3.3.2.2.1 Insufficient specimen thickness.

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

3.3.2.2.3 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.

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

3.3.3 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 based on correlation with notch tensile strength/tensile yield strength (NTS/TYS) ratio 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 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 a procedure, based on ASTM E338, agreed upon by purchaser and vendor on specimens taken in both the longitudinal and long-transverse directions. The specimens shall conform to Fig. 1 (See 8.2) for plate over 0.749 to 1.499 in. (19.02 to 38.07 mm), incl, in nominal thickness and to either Fig. 2 or Fig. 3 (See 8.2) for plate over 1.499 to 4.000 in. (38.07 to 101.60 mm), incl, in nominal thickness. 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 Conductivity: Shall be not lower than 41% IACS (International Annealed Copper Standard).

3.3.4.1 Plate having conductivity lower than 41% IACS may be given additional precipitation heat treatment and if, upon completion of such treatment, it develops conductivity conforming to 3.3.4, it shall be acceptable.

3.3.5 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 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 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 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:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties (3.3.1), notch tensile strength/tensile yield strength ratio (3.3.2), fracture toughness (3.3.3), conductivity (3.3.4), 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 indicates that the established correlation is met.

4.2.2 Periodic Tests: Tests to determine conformance to stress-corrosion resistance (3.3.5) requirements 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; the frequency and extent of sampling for periodic tests shall be as agreed upon by purchaser and vendor; an inspection lot for tensile properties, notch tensile strength/tensile yield strength ratio, fracture toughness, and conductivity shall be all plate traceable to a heat treat lot and submitted 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, material specification number, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, 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 a statement that the plate conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 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 4202, inspection lot number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be clearly 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. (152 mm) Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm). The inspection lot number may appear in the row marking or may appear at only one location on each plate.

5.1.2 Flat Plate 0.375 In. (9.52 mm) and Under Thick, 6 - 60 In. (152 - 1524 mm), Incl, Wide and 36 - 200 In. (914 - 5080 mm), Incl, Long: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm), the rows being spaced approximately 6 in. (152 mm) on centers across the width and staggered. Every third row shall show the manufacturer's identification and nominal thickness. The other rows shall show the alloy number and temper and AMS 4202. The inspection lot number may be included in the rows with the alloy number and temper and specification designation or may appear at only one location on each plate.

5.1.3 Flat Plate Over 0.375 In. (9.52 mm) Thick, or Over 60 In. (1524 mm) Wide, or Over 200 In. (5080 mm) Long: Shall be marked as in 5.1.2 or, at vendor's discretion, shall be marked in one or two rows of characters recurring at intervals not greater than 3 ft (914 mm) and running around the periphery of the plate. If one row is used, it shall show all information of 5.1 except that the inspection lot number may be omitted. If two rows are used, one row shall show the alloy number and temper and AMS 4202; the second row shall show the manufacturer's identification and nominal thickness. The inspection lot number may be included in the line with the manufacturer's identification and nominal thickness or may appear at only one location on each plate.

5.1.3.1 If peripheral marking is applied, to the full plate as produced but partial plates are supplied, an arrow shall also be applied near one corner indicating the direction of rolling.

5.2 Protective Treatment: Flat plate shall be protected during shipment and storage by interleaving with suitable paper sheets.

5.3 Packaging:

5.3.1 Plate shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the plate to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-649, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.3.1 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Plate not conforming to this specification or to authorized modifications will be subject to rejection.

8. NOTES:

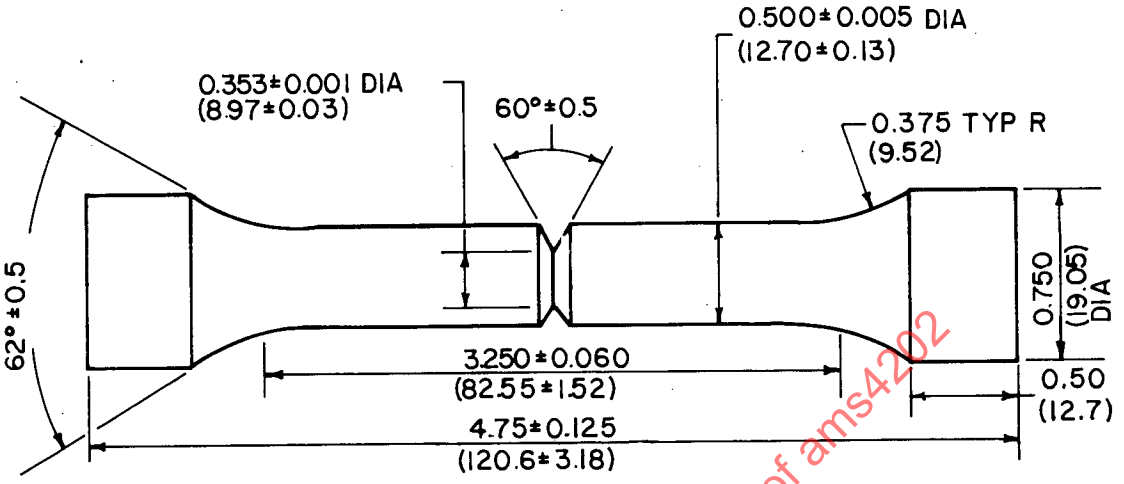
8.1 Dimensions and properties in U.S. Conventional units are primary; dimensions and properties in SI units are shown as the equivalents of the U.S. Conventional units and are not to be construed as standard for product produced to SI dimensions.

8.2 The notch tensile strength is directly dependent upon specimen shape and thickness so it is imperative that the geometry shown in Fig. 1 and 2 or 3 be used. In addition, the results of notch tensile tests are extremely susceptible to misalignment and every effort should be made to control alignment.

8.3 Specimen Orientation for Fracture Toughness Tests: L-T stress is applied in the longitudinal grain direction with crack propagating in the long-transverse grain direction, T-L stress is applied in the long-transverse grain direction with crack propagating in the longitudinal grain direction, and S-L stress is applied in the short-transverse grain direction with crack propagating in the longitudinal grain direction.

8.4 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Size of plate desired
Quantity of plate desired
Applicable level of packaging (See 5.3.2).



USE 7/8
(22.2) DIA
CUTTER NO. 14
CENTER BOTH ENDS

Notch Root Radius 0.0007 (0.018) Max
Symmetrical About Centerline ± 0.002 (± 0.05)
Tolerance ± 0.010 (± 0.25) Unless Otherwise Specified

Linear Dimensions are in inches (millimetres).
Surface Texture 63 microinches (1.6 µm) per ANSI B46.1.

ROUND NOTCHED TENSILE SPECIMEN - 0.500 (12.70) DIA

FIGURE 1