

UNS A97475

ALUMINUM ALLOY SHEET, ALCLAD
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T61)
Solution and Precipitation Heat Treated

1. SCOPE:

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

1.2 Application: Primarily for parts in structural applications requiring high strength, 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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2202 - Tolerances, Aluminum Alloy and Magnesium 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

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

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade or their use by governmental agencies is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

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:

	Core (7475)		Cladding (7072)	
	min	max	min	max
Zinc	5.2	6.2	Zinc	0.8 - 1.3
Magnesium	1.9	2.6	Silicon + Iron	-- 0.7
Copper	1.2	1.9	Magnesium	-- 0.10
Chromium	0.18	0.25	Copper	-- 0.10
Iron	--	0.12	Manganese	-- 0.10
Silicon	--	0.10	Other Impurities, each	-- 0.05
Manganese	--	0.06	Other Impurities, total	-- 0.15
Titanium	--	0.06	Aluminum	remainder
Other Impurities, each	--	0.05		
Other Impurities, total	--	0.15		
Aluminum	remainder			

3.2 Condition: Solution and precipitation heat treated. Heat treatment shall be performed in equipment and under controls meeting the requirements of MIL-H-6088.

3.3 Properties: Sheet 0.040 in. (1.00 mm) and over in nominal thickness shall conform to the following requirements, determined in accordance with AMS 2355 except that notch tensile testing shall be performed as in 3.3.3.1. Tensile properties, notch tensile strength/tensile yield strength ratio, and apparent critical-stress-intensity factor requirements for sheet less than 0.040 in. (1.00 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.1 Tensile Properties: Shall be as specified in Table I.

TABLE I

Nominal Thickness Inch	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. %, min
0.040 to 0.062, incl	69,000	59,000	9
Over 0.062 to 0.187, incl	70,000	60,000	9
Over 0.187 to 0.249, incl	72,000	61,000	9

TABLE 1 (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm %, min
1.00 to 1.55, incl	475	405	9
Over 1.55 to 4.75, incl	485	415	9
Over 4.75 to 6.25, incl	495	420	9

3.3.2 Apparent Critical-Stress-Intensity Factor: Apparent critical-stress-intensity factor (K_{qc}), determined in accordance with 3.3.2.1 or as agreed upon by purchaser and vendor, shall be as follows:

Nominal Thickness		K_{qc} , min	
Inch	(Millimetres)	ksi $\sqrt{\text{in.}}$	(MPa $\sqrt{\text{m}}$)
0.040 to 0.125, incl	(1.00 to 3.10, incl)	75	(82.4)
Over 0.125 to 0.249, incl	(Over 3.10 to 6.25, incl)	60	(66.0)

3.3.2.1 Panels as in 4.3.1 shall be fixtured in a tensile test machine so that the jaw separation is 32 in. (800 mm) and the slot is centered between the jaws. Panels shall be stressed in the long-transverse direction at a rate of approximately 50,000 psi (345 MPa) per min. on the net section and the crack length at instability determined by a plot of load versus specimen deformation. The latter shall be measured using a compliance gage reading over a gage length of at least two-thirds the panel width and a suitable compliance correlation. Check measurements should also be made by direct visual observation. Values of K_{qc} shall be calculated by the following equation:

$$K_{qc} = \frac{P(a)}{BW}^{1/2} \left[1.77 + 0.227 \left(\frac{2a}{W} \right) - 0.510 \left(\frac{2a}{W} \right)^2 + 2.7 \left(\frac{2a}{W} \right)^3 \right]$$

Where, k_{qc} = Apparent critical-stress-intensity factor,
ksi $\sqrt{\text{in.}}$ (MPa $\sqrt{\text{m}}$)

P = Load at fracture instability (maximum load), in
thousands of pounds (MN)

2a = Total crack length at fracture instability, in. (mm)

B = Thickness, in. (mm)

W = Width, in. (mm)

3.3.2.2 All K_{qc} data are based on specimens which have not buckled during testing. Anti-buckling guides may be used for sheet thicknesses 0.157 in. (4 mm) and under.

3.3.3 Notch Tensile Strength/Tensile Yield Strength Ratio (NTS/TYS): The producer may guarantee that the sheet meets the apparent critical-stress-intensity factor (K_{Ic}) requirements based on correlation with notch tensile strength/tensile yield strength (NTS/TYS) ratio in lieu of determining the apparent critical-stress-intensity factor (3.3.2) provided that he has established correlation between the two tests for his sheet and the correlation is approved by purchaser.

3.3.3.1 Notch tensile strength in the long-transverse direction shall be determined in accordance with ASTM E338 on specimens as in 4.3.2 conforming to Fig. 1 of this specification. The values shall be divided by the long-transverse tensile yield strength to obtain the NTS/TYS ratio.

3.3.4 Bending: Sheets 0.008 to 0.249 in. (0.20 to 6.25 mm), incl, in nominal thickness shall withstand, without cracking, bending at room temperature through an angle of 180 deg around a diameter equal to the bend factor times the nominal thickness of the sheet with axis of bend parallel to the direction of rolling.

Nominal Thickness		Bend Factor
Inch	(Millimetres)	
0.008 to 0.020, incl	0.20 to 0.50, incl	6
Over 0.020 to 0.063, incl	(Over 0.50 to 1.60, incl)	7
Over 0.063 to 0.091, incl	(Over 1.60 to 2.30, incl)	8
Over 0.091 to 0.125, incl	(Over 2.30 to 3.10, incl)	9
Over 0.125 to 0.249, incl	(Over 3.10 to 6.25, incl)	10

3.3.5 Cladding Thickness Per Side: Shall be as follows:

Nominal Sheet Thickness		Cladding Thickness % of Sheet Thickness	
Inch	(Millimetres)	Nominal	Min Average
Up to 0.062, incl	(Up to 1.55, incl)	4	3.2
Over 0.062 to 0.187, incl	(Over 1.55 to 4.75, incl)	2.5	2.0
Over 0.187 to 0.249, incl	(Over 4.75 to 6.25, incl)	1.5	1.2

3.4 Quality: Sheet, 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 sheet.

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 sheet 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 sheet 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), apparent critical-stress-intensity factor (3.3.2), notch tensile strength/tensile yield strength ratio (3.3.3), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot, except that the apparent critical-stress-intensity factor need not be determined if the notch tensile strength/tensile yield strength ratio requirements are met.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for bending (3.3.4) and cladding thickness (3.3.5) 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, notched tensile strength/tensile yield strength ratio and apparent critical-stress-intensity factor shall be all sheet traceable to a heat treat lot and submitted for vendor's inspection at one time.

4.3.1 Specimens for the critical-stress-intensity factor (3.3.2) test shall be panels nominally 44 in. (1100 mm) long by 16 in. (400 mm) wide by the thickness of the sheet. The 44 in. (1100 mm) dimension shall be in the long-transverse direction. The panel shall have a slot 4 in. (100 mm) in length centered on the length and width of the specimen with the length of the slot parallel to the width of the specimen. The last 0.50 in. (12.5 mm) of each end of the slot shall be a sawed slot not over 0.010 in. (0.25 mm) wide.

4.3.2 Specimens for notch-tensile testing (3.3.3) shall be taken from sheet in the long-transverse direction. Configuration of the specimen shall conform to Fig. 1.

4.4 Reports:

4.4.1 The vendor of sheet shall furnish with each shipment three copies of a report stating that the sheet conforms to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, inspection lot number, AMS 4207, size, and quantity.

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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, AMS 4207, contractor or other direct supplier of sheet, part number, and quantity. When sheet for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of sheet to determine conformance to the requirements of this specification and shall include in the report either a statement that the sheet 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.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each sheet shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4207, 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 sheet or its performance.

5.1.1 Flat Sheet 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 piece.

5.1.2 Flat Sheet 6 - 60 In. (150 - 1500 mm), Incl, Wide, and 36 - 200 In. (900 - 5000 mm), Incl, Long: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (900 mm), the rows being spaced approximately 6 in. (150 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 4207. The inspection lot number may be included in the rows with the alloy number, temper, and specification designations or may appear at only one location on each piece.

5.1.3 Flat Sheet Over 60 In. (1500 mm) Wide, or Over 200 In. (5000 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 (900 mm) and running around the periphery of the piece. 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 4207, 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 piece.