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

AEROSPACE MATERIAL SPECIFICATION

AMS 4100

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Revised

UNS A97475

ALUMINUM ALLOY SHEET, ALCLAD
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T761)

1. SCOPE:

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

1.2 Application: Primarily for structural applications requiring material with high strength and resistance to exfoliation-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 G34 - Exfoliation Corrosion Susceptibility in 7XXX Series Copper Containing Aluminum Alloys (EXCO Test)

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-H-6088 - Heat Treatment of Aluminum Alloys

2.3.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

Printed in U.S.A.

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined in accordance with AMS 2355:

Core (7475)	min	max	Cladding (7072)	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. (1.02 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. (1.02 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	66,000	55,000	9
Over 0.062 to 0.187, incl	67,000	56,000	9
Over 0.187 to 0.249, incl	69,000	57,000	9

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm %, min
1.02 to 1.57, incl	455	379	9
Over 1.57 to 4.75, incl	462	386	9
Over 4.75 to 6.32, incl	476	393	9

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

Nominal Thickness		Kqc, min	
Inch	(Millimetres)	ksi $\sqrt{in.}$	(MPa $\sqrt{m}$)
0.040 to 0.125, incl	(1.02 to 3.18, incl)	80	(87.9)
Over 0.125 to 0.249, incl	(Over 3.18 to 6.32, incl)	70	(76.9)

3.3.2.1 Panels as in 4.3.2 shall be fixtured in a tensile test machine so that the jaw separation is 32 in. (813 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 Kqc shall be calculated by the following equation:

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

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

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 Kqc 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): Unless otherwise specified, the producer may guarantee that the sheet meets the apparent critical-stress-intensity factor (Kqc) 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.

3.3.3.1 Notch tensile strength in the long-transverse direction shall be determined in accordance with ASTM E338 on specimens 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 Conductivity:

3.3.4.1 Conductivity shall be determined on the core after removal of the cladding.

3.3.4.2 If the conductivity is 39% IACS (International Annealed Copper Standard) or greater and the yield strength does not exceed the specified minimum by 9000 psi (62 MPa) or more, the sheet is acceptable.

3.3.4.3 If the conductivity is 39% IACS or greater and the yield strength exceeds the specified minimum by 9000 psi (62 MPa) or more, the sheet shall also meet the requirements of 3.3.5.

3.3.4.4 If the conductivity is at least 38% IACS but less than 39% IACS, the sheet shall also meet the requirements of 3.3.5.

3.3.4.5 If the conductivity is less than 38% IACS, the sheet is not acceptable.

3.3.4.5.1 Sheet found to be unacceptable may be given additional precipitation heat treatment and if, upon completion of such treatment, it develops conductivity/property relationships conforming to 3.3.4.2, 3.3.4.3, or 3.3.4.4, it shall be acceptable.

3.3.5 Exfoliation Resistance: Sheet shall not show exfoliation equal to or greater than that illustrated by Photo B, Fig. 2 of ASTM G34 after being tested in accordance with ASTM G34. The cladding shall be removed from the test surface. For sheet 0.100 in. (2.54 mm), or thicker, 10% of the thickness shall be removed by machining one surface. The cladding present on the surface opposite the test surface shall also either be removed or masked off.

3.3.6 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 1.57, incl)	4	3.2
Over 0.062 to 0.187, incl	(Over 1.57 to 4.75, incl)	2.5	2.0
Over 0.187 to 0.249, incl	(Over 4.75 to 6.32, 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 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 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), conductivity (3.3.4), 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 exfoliation resistance (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, apparent critical-stress-intensity factor, and conductivity shall be all sheet traceable to a heat treat lot and submitted for vendor's inspection at one time.

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

4.3.2 Specimens for the critical-stress-intensity factor test shall be panels nominally 44 in. (1118 mm) long by 16 in. (406 mm) wide by the thickness of the sheet. The 44 in. (1118 mm) dimension shall be in the long transverse direction. The panel shall have a slot 4 in. (102 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. (12.7 mm) of each end of the slot shall be a sawed slot not over 0.010 in. (0.25 mm) wide.

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

4.3.4 At least one sample shall be taken from each lot for exfoliation resistance testing if the yield strength exceeds the specified minimum by more than 9000 psi (62 MPa).

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, 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 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 a statement that the sheet 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 sheet shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4100, 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 sheet or its performance.

5.1.1 Flat Sheet 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 piece.

5.1.2 Flat Sheet 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 4100. The inspection lot number may be included in the rows with the alloy, temper, and specification designations or may appear at only one location on each piece.