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

AEROSPACE MATERIAL SPECIFICATION

AMS 4041L
Superseding AMS 4041K
Issued 11-1-41
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ALUMINUM ALLOY SHEET AND PLATE, ALCLAD
4.4Cu - 1.5Mg - 0.60Mn
(Alclad 2024 and 1-1/2% Alclad 2024, - T3 Flat Sheet; 1-1/2% Alclad 2024-T351 Plate)

1. SCOPE:

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

1.2 Application: Primarily for formed structural parts of good strength which are required to exhibit maximum corrosion resistance. Plate is also suitable for structural machined parts where warpage, during machining, due to residual stresses must be minimized. Certain design and processing procedures may cause these products to be susceptible to stress-corrosion cracking; ARP 823 recommends practices to minimize such conditions.

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

2.1.2 Aerospace Recommended Practices:

ARP 823 - Minimizing Stress Corrosion in Wrought Heat Treatable Aluminum Alloy Products

2.2 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.2.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.2.2 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 (2024)	min	max	Cladding (1230)	min	max
	Copper	3.8	4.9	Iron + Silicon	--	0.7
	Magnesium	1.2	1.8	Copper	--	0.10
	Manganese	0.30	0.9	Zinc	--	0.10
	Iron	--	0.50	Manganese	--	0.05
	Silicon	--	0.50	Magnesium	--	0.05
ø	Zinc	--	0.25	Vanadium	--	0.05
	Titanium	--	0.15	Titanium	--	0.03
	Chromium	--	0.10	Other Impurities, each	--	0.03
	Other Impurities, each	--	0.05	Aluminum, by difference	99.30	--
	Other Impurities, total	--	0.15			
	Aluminum	remainder				

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Sheet: Solution heat treated in accordance with MIL-H-6088 and cold worked.

3.2.2 Plate: Solution heat treated in accordance with MIL-H-6088 and stretched to produce a nominal permanent set of 2% but not less than 1-1/2% nor more than 3%.

3.2.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties: The product shall conform to the following requirements, determined in accordance with AMS 2355:

3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.1.

TABLE I

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
0.008 to 0.009, incl	58,000	39,000	10
Over 0.009 to 0.020, incl	59,000	39,000	12
Over 0.020 to 0.062, incl	59,000	39,000	15
Over 0.062 to 0.128, incl	61,000	40,000	15
Over 0.128 to 0.187, incl	62,000	40,000	15
ø Over 0.187 to 0.249, incl	63,000	41,000	15
Over 0.249 to 0.499, incl	63,000	41,000	12
Over 0.499 to 1.000, incl	63,000	42,000	8
Over 1.000 to 1.500, incl	62,000	42,000	7
Over 1.500 to 2.000, incl	62,000	42,000	6
Over 2.000 to 3.000, incl	60,000	42,000	4
Over 3.000 to 4.000, incl	57,000	41,000	4

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
0.20 to 0.23, incl	400	269	10
Over 0.23 to 0.51, incl	407	269	12
Over 0.51 to 1.57, incl	407	269	15
Over 1.57 to 3.25, incl	421	276	15
Over 3.25 to 4.75, incl	427	276	15
Over 4.75 to 6.32, incl	434	283	15
Over 6.32 to 12.67, incl	434	283	12
Over 12.67 to 25.40, incl	434	290	8
Over 25.40 to 38.10, incl	427	290	7
Over 38.10 to 50.80, incl	427	290	6
Over 50.80 to 76.20, incl	414	290	4
Over 76.20 to 101.60, incl	393	283	4

3.3.1.1 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 Bending: Product 0.008 to 0.499 in. (0.20 to 12.67 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 product with axis of bend parallel to the direction of rolling.

Nominal Thickness Inch	(Millimetres)	Bend Factor
0.008 to 0.040, incl	(0.20 to 1.02, incl)	4
Over 0.040 to 0.128, incl	(Over 1.02 to 3.25, incl)	5
Over 0.128 to 0.249, incl	(Over 3.25 to 6.32, incl)	8
Over 0.249 to 0.499, incl	(Over 6.32 to 12.67, incl)	10

3.3.2.1 Bending requirements for plate over 0.499 in. (12.67 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.3 Cladding Thickness: After rolling, the average cladding thickness shall be as specified in Table II.

TABLE II

Nominal Thickness Inches	(Millimetres)	Cladding Thickness Per Side % of Total Thickness min	max
0.008 to 0.062, incl	(0.20 to 1.57, incl)	4.0	--
Over 0.062 to 0.187, incl	(Over 1.57 to 4.75, incl)	2.0	--
Over 0.187 to 0.499, incl	(Over 4.75 to 12.67, incl)	1.2	--
Over 0.499	(Over 12.67)	1.2	3.0

3.4 Quality: The product, 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 product.

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 the product 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 product 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), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for bending (3.3.2) and cladding thickness (3.3.3) 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.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report stating that the product conforms to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, 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 and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material 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 and plate shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4041 or applicable Federal or Military specification designation, manufacturer's identification, and nominal thickness. The alloy number shall be "Alclad 2024" for sheet 0.187 in. (4.75 mm) and under in nominal thickness and "1-1/2% Alclad 2024" for sheet and plate over 0.187 in. (4.75 mm) in 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 product or its performance.

5.1.1 Flat Sheet and 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).

5.1.2 Flat Sheet and 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 4041 or applicable Federal or Military specification designation.