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

AEROSPACE MATERIAL SPECIFICATION

AMS 4036E
Superseding AMS 4036D
Issued 1-15-61
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ALUMINUM ALLOY SHEET AND PLATE, ALCLAD ONE SIDE
4.4Cu - 1.5Mg - 0.60Mn
(Alclad One Side 2024 and 1-1/2% Alclad One Side 2024-T3 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 structural use, including chemically milled parts. Certain design and processing procedures may cause this material 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

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
Zinc	--	0.25	Vanadium	--	0.05
Zirconium + Titanium	--	0.20	Titanium	--	0.03
Titanium	--	0.15	Other Impurities, each	--	0.03
Chromium	--	0.10	Aluminum, by difference	99.30	--
Other Impurities, each	--	0.05			
Other Impurities, total	--	0.15			
Aluminum	remainder				

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

Ø 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 Ø 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 Ø with AMS 2355:

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

TABLE I

Nominal Thickness Inch	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
0.010 to 0.020, incl	61,000	40,000	12
Over 0.020 to 0.062, incl	61,000	40,000	15
Over 0.062 to 0.249, incl	63,000	41,000	15
Over 0.249 to 0.499, incl	63,000	41,000	12

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
0.25 to 0.51, incl	421	276	12
Over 0.51 to 1.57, incl	421	276	15
Over 1.57 to 6.32, incl	434	283	15
Over 6.32 to 12.67, incl	434	283	12

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

3.3.2 Bending: Product 0.010 to 0.249 in. (0.25 to 6.32 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. The bare (unclad) surface shall be on the outside of the bend.

Nominal Thickness		Bend Factor
Inch	(Millimetres)	
0.010 to 0.040, incl	(0.25 to 1.02, incl)	4
Over 0.040 to 0.124, incl	(Over 1.02 to 3.15, incl)	5
Over 0.124 to 0.249, incl	(Over 3.15 to 6.32, incl)	8

3.3.2.1 Bending requirements for plate over 0.249 in. (6.32 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		Cladding Thickness Per Side % of Thickness, min
Inch	(Millimetres)	
0.010 to 0.062, incl	(0.25 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

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 composition (3.1), tensile property (3.3.1), and tolerance (3.5) requirements are classified as acceptance tests.

4.2.2 Periodic Tests: Tests to determine conformance to bending (3.3.2) and cladding thickness (3.3.3) requirements are classified as periodic tests.

4.3 Sampling: Shall be in accordance with AMS 2355. Frequency and extent of sampling for periodic tests shall be as agreed upon by purchaser and vendor.

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.

Ø 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 the bare (unclad) face, in the respective location indicated below, with the alloy number and temper, AMS 4036, manufacturer's identification, and nominal thickness. The alloy number shall be "Alclad one side 2024" for sheet 0.187 in. (4.75 mm) and under in nominal thickness and "1-1/2% Alclad one side 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 4036.

5.1.3 Flat Sheet and 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 piece. If one row is used, it shall show all information of 5.1. If two rows are used, one row shall show the alloy number and temper and AMS 4036; the second row shall show the manufacturer's identification and nominal thickness.

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

5.1.4 Coiled Sheet: Shall be marked near both the outside and inside ends of the coil; the markings shall Ø be applied as in 5.1 or shall appear on a durable tag or label attached to the coil and marked with the information of 5.1. When the inside end of the coil is inaccessible, as when the sheet is wound on cores, the tag or label may be attached to the core.

5.1.5 Circles: Shall be marked with the information of 5.1 if the circle is 24 in. (610 mm) or more in nominal diameter. Circles less than 24 in. (610 mm) in nominal diameter shall be identified as agreed upon by purchaser and vendor.