SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4296A

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Superseding AMS 4296

Aluminum Alloy, Alclad Sheet and Plate
4.3Cu - 1.4Mg - 0.60Mn (Alclad 2524-T3)
Solution Heat Treated and Cold Worked

(Composition similar to UNS A82524)

1. SCOPE:

1.1 Form:

This specification covers an aluminum alloy in the form of sheet and plate clad on both sides.

1.2 Application:

These products have been used typically for formed structural aircraft parts requiring improved resistance to fatigue crack growth and high toughness with strength similar to Alclad 2024-T3, but usage is not limited to such applications.

1.2.1 Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking; ARP823 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS:

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent supplied herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
AMS 2772	Heat Treatment of Aluminum Alloy Raw Materials
ARP823	Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products
AS1990	Aluminum Alloy Tempers

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666/B 666M	Identification Marking of Aluminum and Magnesium Products
ASTM E 647	Measurement of Fatigue Crack Growth Rates

2.3 ANSI Publications:

Available from ANSI, 25 West 43rd Street, New York, NY 10036 or www.ansi.org.

ANSI H35.2	Dimensional Tolerances for Aluminum Mill Products
ANSI H35.2M	Dimensional Tolerances for Aluminum Mill Products (Metric)

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Tables 1 and 2, determined in accordance with AMS 2355.

TABLE 1 - Composition, Core (2524)

Element	min	max
Silicon	--	0.06
Iron	--	0.12
Copper	4.0	4.5
Manganese	0.45	0.7
Magnesium	1.2	1.6
Chromium	--	0.05
Zinc	--	0.15
Titanium	--	0.10
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

TABLE 2 - Composition, Cladding (1230)

Element	min	max
Silicon + Iron	--	0.7
Copper	--	0.10
Manganese	--	0.05
Magnesium	--	0.05
Zinc	--	0.10
Titanium	--	0.03
Vanadium	--	0.05
Other Elements, each	--	0.03
Aluminum, by difference	99.3	--

3.2 Condition:

Solution heat treated in accordance with AMS 2772 and cold worked to T3 temper (See AS1990).

3.3 Properties:

Product shall conform to the following requirements, determined in accordance with AMS 2355 on the mill product:

3.3.1 Long-Transverse Tensile Properties: Shall be as shown in Table 3.

TABLE 3A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 inches or 4D %
0.032 to 0.062, incl	59.0	39.0	15
Over 0.062 to 0.128, incl	61.0	40.0	15
Over 0.128 to 0.310, incl	62.0	40.0	15

TABLE 3B - Minimum Tensile Properties, SI Units

Nominal Thickness Millimeters	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 inches or 4D %
0.81 to 1.57, incl	407	269	15
Over 1.57 to 3.25, incl	421	276	15
Over 3.25 to 7.87, incl	427	276	15

3.3.2 Fatigue Crack Growth Rate (FCGR): Shall be not higher than the rate (da/dN) shown in Table 4, determined in the T-L orientation in accordance with ASTM E 647, and using the center-cracked tension M(T) specimen, a DK of 30 ksi$\sqrt{\text{inch}}$ (33 MPa$\sqrt{\text{m}}$), a K gradient of zero, a stress ratio (R) of plus 0.1, and a testing frequency between 2 to 10 Hertz.

TABLE 4 - Maximum Fatigue Crack Growth Rate

Nominal Thickness Inch	Nominal Thickness Millimeters	da/dN inch/cycle	da/dN mm/cycle
0.032 to 0.310, incl	0.81 to 7.87, incl	1.2×10^{-4}	3.05×10^{-3}

3.3.3 Bending: Product shall withstand, without cracking, bending at room temperature through an angle of 180 degrees around a diameter equal to the bend factor shown in Table 5 times the nominal thickness of the product with axis of bend parallel to the direction of rolling.

TABLE 5 - Bending Parameters

Nominal Thickness Inch	Nominal Thickness Millimeters	Bend Factor
0.032 to 0.040, incl	0.81 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 0.310, incl	Over 6.32 to 7.87, incl	10

3.3.4 Minimum Average Cladding Thickness: Shall be as shown in Table 6.

TABLE 6 - Minimum Average Cladding Thickness

Nominal Thickness Inch				Nominal Thickness Millimeters				Cladding Thickness Per Side % of Total Thickness
	0.032	to	0.062, incl		0.81	to	1.57, incl	4.0
Over	0.062	to	0.310, incl	Over	1.57	to	7.87, incl	2.0

3.4 Quality:

Product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.5 Tolerances:

Shall conform to all applicable requirements of ANSI H35.2 or ANSI H35.2M.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), tensile properties (3.3.1), fatigue-crack growth rate (3.3.2), and tolerances (3.5) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.2.2 Periodic Tests: Bending (3.3.3) and cladding thickness (3.3.4) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2355. One chemical composition analysis shall be determined for each ingot casting drop and one fatigue crack growth test shall be performed on each inspection lot.