AEROSPACE MATERIAL SPECIFICATION

AMS4296™	REV. D

Issued 1997-09
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Revised 2023-05

Superseding AMS4296C

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)

RATIONALE

AMS4296D results from a Five-Year Review and update of this specification with changes to relocate definitions (2.4), update wording to prohibit unauthorized exceptions (3.3.3, 3.6, and 8.4), update applicable documents (Section 2), and allow the use of the immediate prior specification revision (8.3).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of sheet and plate 0.032 to 0.310 inch (0.81 to 7.87 mm), inclusive, in thickness, clad on both sides (see 8.5).

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 specified 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.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2355 Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloy, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS4296D/

ARP823 Minimizing Stress-Corrosion Cracking in Wrought, High-Strength Aluminum Alloy Products

AS7766 Terms Used in Aerospace Metals Specifications

2.2 ANSI Accredited Publications

Copies of these documents are available online at https://webstore.ansi.org/.

ANSI H35.1/H35.1M Standard Alloy and Temper Designation System for Aluminum

ANSI H35.2 Dimensional Tolerances for Aluminum Mill Products

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

2.3 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B666/B666M Identification Marking of Aluminum and Magnesium Products

ASTM E647 Measurement of Fatigue Crack Growth Rates

2.4 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Tables 1 and 2, determined in accordance with AMS2355.

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	99.30	--

3.2 Condition

Solution heat treated in accordance with AMS2772 and cold worked to T3 temper (refer to ANSI H35.1/H35.1M).

3.3 Properties

Product shall conform to the following requirements, determined in accordance with AMS2355 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	59.0	39.0	15
0.063 to 0.128	61.0	40.0	15
0.129 to 0.310	62.0	40.0	15

Table 3B - Minimum tensile properties, SI units

Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
0.81 to 1.57	407	269	15
1.60 to 3.25	421	276	15
3.28 to 7.87	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 E647, and using the center-cracked tension M(T) specimen, a ΔK of 30 ksi√inch (33 MPa√m), a K gradient of zero, a stress ratio (R) of +0.1, and a testing frequency between 2 to 10 Hz.

Table 4 - Maximum fatigue crack growth rate

Nominal Thickness Inches	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 Mechanical property requirements for product outside of the range covered by 1.1 shall be agreed upon between the purchaser and producer and reported per 4.4.1 (see 8.5).

3.3.4 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 Inches	Nominal Thickness Millimeters	Bend Factor
0.032 to 0.040	0.81 to 1.02	4
0.041 to 0.128	1.04 to 3.25	5
0.129 to 0.249	3.28 to 6.32	8
0.250 to 0.310	6.35 to 7.87	10

3.3.5 Minimum Average Cladding Thickness

Shall be as shown in Table 6.

Table 6 - Minimum average cladding thickness

Nominal Thickness Inches	Nominal Thickness Millimeters	Average Cladding Thickness per Side % of Total Thickness Minimum
0.032 to 0.062	0.81 to 1.57	4.0
0.063 to 0.310	1.60 to 7.87	2.0

3.4 Quality

Product, as received by the 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.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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.