AEROSPACE MATERIAL SPECIFICATION

AMS4330™	REV. E

Issued 2001-11
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Superseding AMS4330D

Aluminum Alloy, Plate (2297-T87)
2.8Cu - 1.5Li - 0.30Mn - 0.12Zr
Solution Heat Treated, Stretched, and Artificially Aged
(Composition similar to UNS A92297)

RATIONALE

AMS4330E results from a Five-Year Review and update of this specification with changes to correct metric value conversions (3.2, Tables 2B and 3B), update general agreement language to prohibit unauthorized exceptions (3.3.1.1, 8.4), applicable documents (Section 2), and stress-corrosion resistance (3.3.2.1).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of plate 1.500 to 6.000 inches (38.1 to 152.40 mm) thick (see 8.5).

1.2 Application

These products have been typically used in aerospace applications where low density is needed in combination with moderate strength, high fatigue resistance, good stress corrosion properties, and improved stiffness, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order form 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

AS7766 Terms Used in Aerospace Metals Specifications

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/AMS4330E/

2.2 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 B594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products
ASTM B645	Linear-Elastic Plane-Strain Fracture Toughness Testing of Aluminum Alloys
ASTM B660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B666/B666M	Identification Marking of Aluminum and Magnesium Products
ASTM E399	Linear-Elastic Plane-Strain Fracture Toughness of Metallic Materials
ASTM G34	Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Test)
ASTM G47	Determining Susceptibility to Stress-Corrosion Cracking of 2XXX and 7XXX Aluminum Alloy Products

2.3 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)

2.4 Definitions

Terms used in AMS are defined in AS7766 and as follows:

2.4.1 PARENT PLATE

A plate that has been processed to final temper as a single unit. The parent plate may subsequently be cut into two or more smaller plates to provide the required width and length.

3. TECHNICAL REQUIREMENTS

3.1 Composition

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

Table 1 - Composition

Element	Min	Max
Silicon	--	0.10
Iron	--	0.10
Copper	2.5	3.1
Manganese	0.10	0.50
Magnesium	--	0.25
Zinc	--	0.05
Titanium	--	0.12
Lithium	1.1	1.7
Zirconium	0.08	0.15
Other Elements, each	--	0.05
Other Elements, total	--	0.15

3.2 Condition

Solution heat treated at 980 to 1000 °F (527 to 538 °C) and rapidly cooled in a suitable quenching medium; stretched to produce a permanent set of at least 2.75% but not more than 6.75%; artificially aged to -T87 temper (refer to ANSI H35.1/H35.1M) at 320 °F (160 °C) for 20 to 48 hours. Aging time shall be dependent upon section thickness composition, and prior processing. Heat treatment shall be performed in accordance with AMS2772.

3.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties

Plate shall conform to the following requirements, determined on the mill produced size in accordance with AMS2355 and as specified herein.

3.3.1 Tensile Properties

Shall be as shown in Table 2.

Table 2A - Minimum tensile properties, inch/pound units

Temper	Thickness Inclusive Inches	Grain Direction	Ultimate Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
-T87	1.500 to 2.000	L	64.0	58.0	10
		LT	66.0	60.0	8
		ST	65.0	57.0	2
	2.001 to 2.500	L	63.0	57.0	9
		LT	65.0	59.0	7
		ST	64.0	56.0	2
	2.501 to 3.000	L	62.0	57.0	9
		LT	64.0	58.0	7
		ST	62.0	55.0	2
	3.001 to 4.000	L	62.0	57.0	5
		LT	62.0	57.0	4
		ST	59.0	54.0	1.5
	4.001 to 5.000	L	61.0	56.0	5
		LT	61.0	56.0	4
		ST	58.0	52.0	1.5
	5.001 to 6.000	L	60.0	55.0	5
		LT	60.0	55.0	4
		ST	57.0	52.0	1.5

Table 2B - Minimum tensile properties, SI units

Temper	Thickness Inclusive Millimeters	Grain Direction	Ultimate Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %	Elongation in 5D or 5.65 √A %
-T87	38.1 to 50.8	L	441	400	10	9
		LT	455	414	8	7
		ST	448	393	2	2
	50.9 to 63.5	L	434	393	9	8
		LT	448	407	7	6
		ST	441	386	2	2
	63.4 to 76.10	L	427	393	9	8
		LT	441	400	7	6
		ST	427	379	2	2
	76.20 to 101.60	L	427	393	5	4
		LT	427	393	4	3
		ST	407	372	1.5	1.5
	101.62 to 127.00	L	421	386	5	4
		LT	421	386	4	3
		ST	400	359	1.5	1.5
	127.02 to 152.40	L	414	379	5	4
		LT	414	379	4	3
		ST	393	359	1.5	1.5

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

3.3.2 Corrosion-Resistance

3.3.2.1 Stress-Corrosion Resistance

Direct tension specimens machined and tested in accordance with ASTM G47 shall show no evidence of stress corrosion failure when stressed in the short-transverse direction at 30.0 ksi (207 MPa) and exposed for 30 days; plate thicknesses 3.001 to 5.100 inches (76.22 to 129.54 mm) shall show no evidence of stress corrosion failure when stressed in the short-transverse direction at 45 ksi (310 MPa) and exposed for 30 days.

3.3.2.2 Exfoliation Corrosion Resistance

When required by the purchaser, specimens from preproduction plates shall show exfoliation corrosion resistance equal to or better than EB when tested at the T/10 plane in accordance with ASTM G34.

3.3.2.3 Plate not meeting the requirements of 3.3.2.1 or 3.3.2.2 may be given additional precipitation heat treatment. After such treatment, if all specified properties are met, the plate is acceptable.

3.3.2.4 Fracture Toughness

Plane strain fracture toughness shall be determined in accordance with ASTM E399 and ASTM B645. A valid K_{Ic} meeting the requirements of ASTM E399, or a K_Q "usable for lot release" in accordance with ASTM B645 shall meet the requirements shown in Table 3. For L-T and T-L test directions, use specimens with 1.5 inch (38.1 mm) minimum thickness. For the S-L test direction, specimen thickness should be maximized to the nearest 0.25 inch (6.35 mm). L-T, T-L, and S-L specimens shall be centered at T/2 for plate 3.000 inches (76.2 mm) and under in nominal thickness and centered at T/4 for plate over 3.000 inches (76.2 mm) in nominal thickness. If a valid K_{Ic} or K_Q "usable for lot release" cannot be obtained due to insufficient specimen ligament size (W - a) or crack length, then the fracture toughness (K_Q) of the specimen will be acceptable for lot release if the following conditions are met:

3.3.2.4.1 The B dimension of the specimen tested shall be the maximum possible up to 2.5 inches (63.5 mm) for the given plate thickness.

3.3.2.4.2 The specimen centerline location shall be maintained at the specified plate thickness location.

3.3.2.4.3 All fracture toughness validity checks except specimen thickness, crack length or P_{max}/P_Q shall meet the criteria of ASTM E399 or ASTM B645.

3.3.2.4.4 If the only invalidity with B = 1.5 inches (38.1 mm) is P_{max}/P_Q, test result is acceptable for lot release.

Table 3A - Minimum fracture parameters, inch/pound units

Temper	Thickness Inclusive Inches	Specimen Orientation	Required Minimum Plane-Strain Fracture Toughness K_{Ic} ksi-in$^{1/2}$
-T87	1.500 to 3.000	L-T	32
		T-L	27
		S-L	20
	3.001 to 4.000	L-T	31
		T-L	27
		S-L	20
	4.001 to 5.000	L-T	30
		T-L	26
		S-L	18
	5.001 to 6.000	L-T	29
		T-L	25
		S-L	18

Table 3B - Minimum fracture parameters, SI units

Temper	Thickness Inclusive Millimeters	Specimen Orientation	Required Minimum Plane-Strain Fracture Toughness K_{Ic} MPa-m$^{1/2}$
-T87	38.10 to 76.10	L-T	35
		T-L	30
		S-L	22
	76.20 to 101.60	L-T	34
		T-L	30
		S-L	22
	101.62 to 127.00	L-T	33
		T-L	29
		S-L	20
	127.02 to 152.40	L-T	32
		T-L	27
		S-L	20

3.4 Quality

Plate, 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 plate. Light scratches and discoloration or streaking shall not be reason for rejection.

3.4.1 Plate shall be ultrasonically inspected in accordance with ASTM B594 and shall meet the requirements of Class A.

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 purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of plate shall supply all samples for producer'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 plate conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1) is an acceptance test and shall be performed on each ingot or each group of ingots poured simultaneously from the same source of molten metal. Tensile properties (3.3.1), fracture toughness (3.3.2.4), and ultrasonic inspection (3.4.1) are acceptance tests and shall be performed on each parent plate.

4.2.2 Periodic Tests

Stress-corrosion resistance (3.3.2.1) is a periodic test and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.