SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4295

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Submitted for recognition as an American National Standard

ALUMINUM ALLOY, SHEET AND PLATE
6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti
(2219 - O, F, T31, T351, T37, T81, T851, T87) UNS A92219

1. SCOPE:

1.1 Form:

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

1.2 Applications:

These products have been used typically for parts requiring good weldability, but usage is not limited to such application.

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 following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

QUESTIONS REGARDING THIS DOCUMENT: (412) 772-7154 FAX (412) 776-0243
TO PLACE A DOCUMENT ORDER: (412) 776-4970 FAX (412) 776-0790

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings
MAM 2355	Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings, Metric (SI) Units
AMS 2770	Heat Treatment of Wrought Aluminum Alloy Parts
AMS 2811	Identification, Aluminum and Magnesium Alloy Wrought Products
ARP823	Minimizing Stress-Corrosion in Wrought Heat-Treatable Aluminum Alloy Products

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM B 594	Ultrasonic Inspection of Aluminum-Alloy Wrought Products for Aerospace Applications

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2154	Inspection, Ultrasonic, Wrought Metals, Process for
MIL-H-6088	Heat Treatment of Aluminum Alloys

2.4 ANSI Publications:

Available from ANSI, 11 West 42nd Street, New York, NY 10036-8002.

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 Table 1, determined in accordance with AMS 2355 or MAM 2355.

TABLE 1 - Composition

Elements	min	max
Copper	5.8	6.8
Manganese	0.20	0.40
Zirconium	0.10	0.25
Vanadium	0.05	0.15
Titanium	0.02	0.10
Iron	--	0.30
Silicon	--	0.20
Zinc	--	0.10
Magnesium	--	0.02
Other Impurities, each	--	0.05
Other Impurities, total	--	0.15
Aluminum	remainder	

3.2 Condition:

Product shall be supplied in one of the following conditions as specified by purchaser. All heat treatment shall be performed in accordance with MIL-H-6088.

3.2.1 Condition F: As fabricated.

3.2.2 Condition O: Annealed.

3.2.3 Condition T31/T351: Solution heat treated and stretched to produce a nominal permanent set of 2%, but not less than 1-1/2% nor more than 3%.

3.2.4 Condition T37: Solution heat treated and stretched to produce approximately 8% permanent set.

3.2.5 Condition T81/T851: Solution heat treated and stretched to produce a nominal permanent set of 2%, but not less than 1-1/2% nor more than 3%, and precipitation heat treated.

3.2.6 Condition T87: Solution heat treated, stretched to produce approximately 8% permanent set, and precipitation heat treated.

3.3 Properties:

Product shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355. In addition, test specimens in the T31, T351, and T37 condition shall not be required to be tested within four days after completion of the heat treatment. If the manufacturer so elects, samples may be tested after less than four days aging, but if they fail to show the specified properties, the test samples may be discarded and additional specimens may be tested after four days aging. These specimens shall be taken from the same locations in the production lot or sample from which the prior specimens were taken.

3.3.1 As Received:

3.3.1.1 Tensile Properties: Shall be as shown in Table 2 (See 8.1). All values are minimum, unless otherwise specified.

TABLE 2A - Tensile Properties, Inch/Pound Units

Temper	Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
O	0.020 to 2.000, incl	32.0 max	16.0 max	12
T31	0.020 to 0.039, incl	46.0	29.0	8
	Over 0.039 to 0.249, incl	46.0	28.0	10
T351	0.250 to 2.000, incl	46.0	28.0	10
	Over 2.000 to 3.000, incl	44.0	28.0	10
	Over 3.000 to 4.000, incl	42.0	27.0	9
	Over 4.000 to 5.000, incl	40.0	26.0	9
	Over 5.000 to 6.000, incl	39.0	25.0	8
T37	0.020 to 0.039, incl	49.0	38.0	6
	Over 0.039 to 2.500, incl	49.0	37.0	6
	Over 2.500 to 3.000, incl	47.0	36.0	6
	Over 3.000 to 4.000, incl	45.0	35.0	5
	Over 4.000 to 5.000, incl	43.0	34.0	4
T81	0.020 to 0.039, incl	62.0	46.0	6
	Over 0.039 to 0.249, incl	62.0	46.0	7
T851	0.250 to 1.000, incl	62.0	46.0	8
	Over 1.000 to 2.000, incl	62.0	46.0	7
	Over 2.000 to 3.000, incl	62.0	45.0	6
	Over 3.000 to 4.000, incl	60.0	44.0	5
	Over 4.000 to 5.000, incl	59.0	43.0	5
	Over 5.000 to 6.000, incl	57.0	42.0	4
T87	0.020 to 0.039, incl	64.0	52.0	5
	Over 0.039 to 0.249, incl	64.0	52.0	6
	Over 0.249 to 1.000, incl	64.0	51.0	7
	Over 1.000 to 3.000, incl	64.0	51.0	6
	Over 3.000 to 4.000, incl	62.0	50.0	4
	Over 4.000 to 5.000, incl	61.0	49.0	3
F	All	no requirement	no requirement	no requirement

TABLE 2B - Tensile Properties, SI Units

Temper	Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
O	0.51 to 50.80, incl	221 max	110 max	12
T31	0.51 to 0.99, incl	317	200	8
	Over 0.99 to 6.32, incl	317	193	10
T351	6.35 to 50.80, incl	317	193	10
	Over 50.80 to 76.20, incl	303	193	10
	Over 76.20 to 101.60, incl	290	186	9
	Over 101.60 to 127.00, incl	276	179	9
	Over 127.00 to 152.40, incl	269	172	8
T37	0.51 to 0.99, incl	338	262	6
	Over 0.99 to 63.50, incl	338	255	6
	Over 63.50 to 76.20, incl	324	248	6
	Over 76.20 to 101.60, incl	310	241	5
	Over 101.60 to 127.00, incl	296	234	4
T81	0.51 to 0.99, incl	427	317	6
	Over 0.99 to 6.32, incl	427	317	7
T851	6.35 to 25.40, incl	427	317	8
	Over 25.40 to 50.80, incl	427	317	7
	Over 50.80 to 76.20, incl	427	310	6
	Over 76.20 to 101.60, incl	414	303	5
	Over 101.60 to 127.00, incl	407	296	5
	Over 127.00 to 152.40, incl	393	290	4
T87	0.51 to 0.99, incl	441	359	5
	Over 0.99 to 6.32, incl	441	359	6
	Over 6.32 to 25.40, incl	441	352	7
	Over 25.40 to 76.20, incl	441	352	6
	Over 76.20 to 101.60, incl	427	345	4
	Over 101.60 to 127.00, incl	421	338	3
F	All	no requirement	no requirement	no requirement

3.3.1.2 Bending: Product in the annealed (O) temper 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 3 times the nominal thickness of the product with axis of bend either parallel to or transverse to the direction of rolling.

TABLE 3 - Bending Parameters for Annealed Product

Nominal Thickness Inch	Nominal Thickness Millimeters	Bend Factor
0.020 to 0.250, incl	0.51 to 6.35, incl	4
Over 0.250 to 0.750, incl	Over 6.35 to 19.05, incl	6
Over 0.750 to 1.000, incl	Over 19.05 to 25.40, incl	8

3.3.1.3 Stress-Corrosion Cracking Resistance: Specimen, cut from plate 0.750 inch (19.05 mm) and over in nominal thickness, supplied in the T851 and T87 conditions, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) to 75% of the yield strength shown in Table 2.

3.3.2 After Solution and Precipitation Heat Treatment:

3.3.2.1 Tensile Properties:

3.3.2.1.1 Product, as received by purchaser in the O and F conditions, without the subsequent imposition of cold working or forming operations after solution and precipitation heat treatment in accordance with time and temperature parameters of AMS 2770 to T62 condition, shall have the tensile properties shown in Table 4 (See 8.1).

3.3.2.1.2 When specified, product, as received by purchaser in the T31, T351, T81, and T851 condition, without the subsequent imposition of cold working or forming operations after heat treatment in accordance with time and temperature parameters of AMS 2770 to T62 condition, shall have the tensile properties shown in Table 4 (See 8.1).

3.3.2.2 Stress-Corrosion Cracking Resistance: When specified, specimens cut from plate 0.750 inch (19.05 mm) and over in nominal thickness, without prior cold working or forming, heat treated to T62 condition in accordance with time and temperature parameters of AMS 2770, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) to 75% of the yield strength shown in Table 2 (See 8.1).

TABLE 4A - 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 %
0.020 to 0.039, incl	54.0	36.0	6
Over 0.039 to 0.249, incl	54.0	36.0	7
Over 0.249 to 1.000, incl	54.0	36.0	8
Over 1.000 to 2.000, incl	54.0	36.0	7

TABLE 4B - 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 %
0.51 to 0.99, incl	372	248	6
Over 0.99 to 6.32, incl	372	248	7
Over 6.32 to 25.40, incl	372	248	8
Over 25.40 to 50.80, incl	372	248	7

3.3.3 After Precipitation Heat Treatment:

3.3.3.1 Tensile: Product, as received by purchaser, in the T31, T351, or T37 condition, and without the subsequent imposition of cold working or forming operations, shall have the tensile properties shown in Table 2 (See 8.1) after precipitation heat treatment in accordance with the time and temperature parameters of AMS 2770 to T81, T851, and T87 condition respectively.

3.3.3.2 Stress-Corrosion Cracking Resistance: Specimens, cut from plate 0.750 inch (19.05 mm) and over in nominal thickness, supplied in the T351 or T37 condition, shall show no evidence of stress-corrosion cracking when stressed in the short-transverse direction (perpendicular to grain flow) to 75% of the yield strength shown for that condition in Table 2 (See 8.1) after precipitation heat treatment in accordance with the time and temperature parameters of AMS 2770 to T851 or T87 condition, respectively.

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.

3.4.1 When specified, plate weighing 200 pounds (907 kg) and under, shall be subjected to ultrasonic inspection in accordance with MIL-STD-2154 or ASTM B 594, and shall meet the requirements shown in Table 5.

TABLE 5 - Ultrasonic Class

Nominal Thickness Inches	Nominal Thickness Millimeters	Class
0.500 to 1.499, incl	12.70 to 38.07, incl	B
Over 1.499 to 3.000, incl	Over 38.07 to 76.20, incl	A
Over 3.000 to 4.500, incl	Over 76.20 to 114.30, incl	B

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: The following requirements are acceptance tests and, except for composition, shall be performed on each inspection lot:

4.2.1.1 Composition (3.1).

4.2.1.2 Tensile properties as received (3.3.1.1).

4.2.1.3 Tensile properties of O and F product after heat treatment to T62 (3.3.2.1.1).

4.2.1.4 When specified, tensile properties of T31, T351, T81, and T851 product after heat treatment to T62 temper (3.3.2.1.2).

4.2.1.5 When specified, tensile properties of T31, T351, and T37 product after precipitation heat treatment to T81, T851, and T87 (3.3.3.1).

4.2.1.6 Tolerances (3.5).