

AEROSPACE MATERIAL SPECIFICATION

SAE AMS4295

REV. D

Issued 1997-04
Stabilized 2013-09

Superseding AMS4295B

Aluminum Alloy, Sheet and Plate
6.3Cu - 0.30Mn - 0.06Ti - 0.10V - 0.18Zr
(2219 - O, F, T31, T351, T37, T81, T851, T87)
(Composition similar to UNS A92219)

RATIONALE

AMS4295D rescinds the cancellation effected with revision C, and designates this specification as stabilized.

STABILIZATION NOTICE

AMS4295D has been declared "STABILIZED" by AMS Committee D and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist. AMS4295 was last reviewed and revised in February, 2006. Users of this document should refer any certification issues (e.g. exceptions listed on the certification report) to the cognizant engineering organization for their disposition. CAUTION: In many cases the purchaser is not the cognizant engineering organization (i.e. purchaser may be a sub tier supplier). AMS Committee D recommends that the following technically equivalent (e.g. properties, fit, form, function) specification be used for future procurement. This listing does not constitute authority to substitute this specification for the "STABILIZED" specification.

Temper	Equivalent Material and Specification
O, F	2219-O or - F in accordance with AMS4031; Aluminum Alloy, Sheet and Plate 6.3Cu - 0.30Mn - 0.18Zr - 0.10V - 0.06Ti (2219-O) Annealed or when specified, "As Fabricated" (2219-F)
T31/T351	2219-T31/T351 in accordance with AMS4601; Aluminum Alloy, Sheet and Plate 6.3Cu - 0.30Mn - 0.06Ti - 0.10V - 0.18Zr Solution Heat Treated, Cold Worked and Naturally Aged (2219 -T31/-T351)
T81/T851	2219-T81/T851 in accordance with AMS4599; Aluminum Alloy, Sheet and Plate 6.3Cu - 0.30Mn - 0.06Ti - 0.10V - 0.18Zr Solution and Precipitation Heat Treated (2219 -T81/-T851)
T37	2219-T37 in accordance with AMS4600; Aluminum Alloy, Sheet and Plate 6.3Cu - 0.30Mn - 0.06Ti - 0.10V - 0.18Zr Solution Heat Treated, Cold Worked (8%) and Naturally Aged (2219 -T37)
T87	2219-T87 in accordance with AMS4613; Aluminum Alloy, Sheet and Plate 6.3Cu - 0.30Mn - 0.06Ti - 0.10V - 0.18Zr Solution Heat Treated, Cold Worked (8%) and Precipitation Heat Treated (2219 -T87)

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on this Technical Report, please visit
<http://www.sae.org/technical/standards/AMS4295D>**

1. SCOPE

1.1 Form

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

1.2 Application

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 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 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

AMS2770 Heat Treatment of Wrought Aluminum Alloy Parts

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

ARP823 Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

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

ASTM B 666/B 666M Identification Marking of Aluminum Products

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, 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 Table 1, determined in accordance with AMS2355.

TABLE 1 - COMPOSITION

Element	min	max
Silicon	--	0.20
Iron	--	0.30
Copper	5.8	6.8
Manganese	0.20	0.40
Magnesium	--	0.02
Zinc	--	0.10
Titanium	0.02	0.10
Vanadium	0.05	0.15
Zirconium	0.10	0.25
Other Elements, each	--	0.05
Other Elements, 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 AMS2772.

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 AMS2355. 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 8.2). 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 AMS2770 to T62 condition, shall have the tensile properties shown in Table 4 (See 8.2).

TABLE 4A - MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Thickness Inch	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

- 3.3.2.1.2 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 AMS2770 to T62 condition, shall have the tensile properties shown in Table 4 (See 8.2).

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 AMS2770, 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 8.2).

3.3.3 After Precipitation Heat Treatment

3.3.3.1 Tensile

Product, as received by purchaser, in the T3, 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 AMS2770 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 AMS2770 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 2000 pounds (907 kg) and under, shall be subjected to ultrasonic inspection in accordance with 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).