AEROSPACE MATERIAL SPECIFICATION

AMS4204™	REV. E

Issued 1982-07
Reaffirmed 2013-05
Revised 2024-11

Superseding AMS4204D

Aluminum Alloy, Plate, 6.2Zn - 1.8Cu - 2.4Mg - 0.13Zr (7010-T7651), Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated (Composition similar to UNS A97010)

RATIONALE

AMS4204E results from a Five-Year Review and update of this specification with changes to update wording to prohibit unauthorized exceptions (see 3.3.6 and 8.4), remove obsolete weight criteria from Ultrasonic Testing (see 3.4.1.1 and 3.4.1.2), relocate Definitions (see 2.4), and update Application (see 1.2) and Applicable Documents (see Section 2).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of plate 0.250 to 5.500 inch (6.35 to 139.70 mm), inclusive, in nominal thickness (see 8.5).

1.2 Application

This plate has been used typically for parts requiring higher tensile strength than 7010-T7351 or 7010-T7451 and resistance to exfoliation corrosion and fracture toughness, 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 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

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/AMS4204E/

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 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 AS776.

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	--	0.12
Iron	--	0.15
Copper	1.5	2.0
Manganese	--	0.10
Magnesium	2.1	2.6
Chromium	--	0.05
Zinc	5.7	6.7
Titanium	--	0.06
Nickel	--	0.05
Zirconium	0.10	0.16
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

3.2 Condition

Solution heat treated, stress relieved by stretching to produce a nominal permanent set of 2% but not less than 1-1/2% nor more than 3%, and precipitation heat treated to the -T7651 temper (refer to ANSI H35.1/H35.1M) 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 in accordance with AMS2355 on the mill product and as specified herein:

3.3.1 Tensile Properties

Shall be as specified in Table 2.

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

Nominal Thickness Inches	Specimen Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
0.250 to 2.000, incl	Longitudinal	76.0	66.0	8
	Long-Trans.	76.0	66.0	6
Over 2.000 to 2.500, incl	Longitudinal	75.0	65.0	8
	Long-Trans.	75.0	65.0	6
	Short-Trans.	71.0	59.0	2.5
Over 2.500 to 3.000, incl	Longitudinal	73.0	64.0	7
	Long-Trans.	74.0	64.0	5
	Short-Trans.	70.0	58.0	2.5
Over 3.000 to 4.000, incl	Longitudinal	72.0	64.0	7
	Long-Trans.	73.0	63.0	5
	Short-Trans.	69.0	56.0	2
Over 4.000 to 5.000, incl	Longitudinal	72.0	63.0	7
	Long-Trans.	72.0	62.0	5
	Short-Trans.	68.0	55.0	2
Over 5.000 to 5.500, incl	Longitudinal	71.0	62.0	6
	Long-Trans.	72.0	61.0	4
	Short-Trans.	66.0	53.0	2

Table 2B - Minimum tensile properties, SI units

Nominal Thickness Millimeters	Specimen Orientation	Tensile Strength, MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
6.35 to 50.80, incl	Longitudinal	524	455	8
	Long-Trans.	524	455	6
Over 50.80 to 63.50, incl	Longitudinal	517	448	8
	Long-Trans.	517	448	6
	Short-Trans.	490	407	2.5
Over 63.50 to 76.20, incl	Longitudinal	503	441	7
	Long-Trans.	510	441	5
	Short-Trans.	483	400	2.5
Over 76.20 to 101.60, incl	Longitudinal	496	441	7
	Long-Trans.	503	434	5
	Short-Trans.	476	386	2
Over 101.60 to 127.00, incl	Longitudinal	496	434	7
	Long-Trans.	496	427	5
	Short-Trans.	469	379	2
Over 127.00 to 139.70, incl	Longitudinal	490	427	6
	Long-Trans.	496	421	4
	Short-Trans.	455	365	2

3.3.2 Conductivity

Shall be not lower than 39.0% IACS (International Annealed Copper Standard) (22.6 MS/m), determined on specimens as in 4.3.1.

3.3.3 Fracture Toughness

When specified (see 8.5), plane-strain fracture toughness shall be tested 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 or exceed the values shown in Table 3. For T-L and L-T test directions for plate over 4 inches (102 mm) in nominal thickness, use specimens 2 inches (51 mm) minimum thickness centered at T/4. For the S-L test direction, the test specimen shall be centered at T/2. Required specimen orientation(s) shall be specified by the purchaser.

Table 3A - Minimum K_{IC} values, inch/pound units

Nominal Thickness Inches	Test Direction	ksi $\sqrt{\text{inch}}$
Over 1.000 to 2.000, incl	L-T	25
	T-L	23
Over 2.000 to 3.000, incl	L-T	24
	T-L	22
	S-L	20
Over 3.000 to 5.000, incl	L-T	22
	T-L	20
	S-L	18
Over 5.000 to 5.500, incl	L-T	20
	T-L	18
	S-L	17

Table 3B - Minimum K_{IC} values, SI units

Nominal Thickness Millimeters	Test Direction	MPa $\sqrt{m}$
Over 25.00 to 51.00, incl	L-T	28
	T-L	25
Over 51.00 to 76.00, incl	L-T	26
	T-L	24
	S-L	22
Over 76.00 to 127.00, incl	L-T	24
	T-L	22
	S-L	20
Over 127.00 to 140.00, incl	L-T	22
	T-L	20
	S-L	19

3.3.4 Exfoliation-Corrosion Resistance

Plate shall achieve an exfoliation rating of EA or better, as illustrated in ASTM G34 at the T/10 plane.

3.3.5 Stress-Corrosion Cracking Resistance

Specimens from plate 0.750 inch (19.05 mm) and over in nominal thickness shall show no evidence of stress-corrosion cracking when tested in accordance with ASTM G47 and stressed in the short-transverse direction to 25.0 ksi (172 MPa).

3.3.6 Mechanical property requirements for plate outside the thickness range of 1.1 shall be as agreed upon by the purchaser and producer and reported per 4.4.1 (see 8.5).

3.4 Quality

Plate, 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 plate.

3.4.1 Each plate shall be ultrasonically inspected in accordance with ASTM B594 and shall meet the following requirements:

3.4.1.1 Plate 0.500 to 2.000 inches (12.70 to 50.80 mm), inclusive in thickness shall meet the requirements for ultrasonic class shown in Table 4.

Table 4 - Ultrasonic class

Nominal Thickness Inches	Nominal Thickness Millimeters	Ultrasonic Class
0.500 to 1.500, excl	12.70 to 38.10, excl	B
1.500 to 2.000, incl	38.10 to 50.80, incl	A

3.4.1.2 The ultrasonic class for plates under 0.500 inch (12.70 mm) or over 2.000 inches (50.80 mm) in nominal thickness shall be acceptable to the purchaser and reported per 4.4.1 (see 8.5).

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.