



AEROSPACE MATERIAL SPECIFICATION	AMS4221™	REV. F
	Issued	1988-07
	Revised	2025-01
Superseding AMS4221E		
Aluminum Alloy, Plate 4.4Cu - 1.5Mg - 0.60Mn (2124-T8151) Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated (Composition similar to UNS A92124)		

RATIONALE

AMS4221F results from a Five-Year Review and update of this specification with changes to prohibit unauthorized exceptions (see 3.3.4, 3.6, 4.4.1, 5.1.1, and 8.4), relocate Definitions (see 2.4), update Applicable Documents (see Section 2), Classification of Tests (see 4.2), rounding of values in Table 3B, and Ordering Information (see 8.5), and allow the use of the immediate prior specification revision (see 8.3).

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of plate 1.500 to 6.000 inches (38.10 to 152.40 mm) in nominal thickness (see 8.6).

1.2 Applications

This plate has been used typically for parts requiring a high level of mechanical properties up to 300 °F (149 °C), but usage is not limited to such applications.

1.2.1 Certain design and fabrication procedures may cause plate 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.

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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
ARP823	Minimizing Stress-Corrosion Cracking in Wrought High-Strength Aluminum Alloy Products
AS7766	Terms Used in Aerospace Metals Specifications

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 Examination 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 Products
ASTM E399	Linear-Elastic Plane-Strain Fracture Toughness (K_{Ic}) of Metallic Materials
ASTM G47	Standard Test Method for 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 H35.2	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.

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	3.8	4.9
Manganese	0.30	0.9
Magnesium	1.2	1.8
Chromium	--	0.10
Zinc	--	0.25
Titanium	--	0.15
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; heat treatment shall be 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 in accordance with AMS2355, except that fracture toughness (see 3.3.3) shall be performed as indicated in the appropriate paragraph; tests are to be performed on the mill-produced size.

3.3.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with AMS2355; tensile properties apply in the long-transverse direction and, when specified, in the longitudinal and/or short-transverse direction.

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 %
1.500 to 2.000, incl	Longitudinal	68.0	62.0	8
	Long-Trans.	68.0	62.0	7
	Short-Trans.	65.0	57.0	2
Over 2.000 to 3.000, incl	Longitudinal	67.0	60.0	8
	Long-Trans.	67.0	60.0	7
	Short-Trans.	64.0	57.0	2
Over 3.000 to 4.000, incl	Longitudinal	67.0	59.0	7
	Long-Trans.	67.0	59.0	6
	Short-Trans.	64.0	57.0	2
Over 4.000 to 5.000, incl	Longitudinal	66.0	58.0	6
	Long-Trans.	66.0	58.0	6
	Short-Trans.	63.0	55.0	2
Over 5.000 to 6.000, incl	Longitudinal	65.0	57.0	6
	Long-Trans.	65.0	56.0	5
	Short-Trans.	62.0	54.0	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 %
38.1 to 50.8, incl	Longitudinal	469	427	8
	Long-Trans.	469	427	7
	Short-Trans.	448	393	2
Over 50.8 to 76.2, incl	Longitudinal	462	414	8
	Long-Trans.	462	414	7
	Short-Trans.	441	393	2
Over 76.2 to 101.6, incl	Longitudinal	462	407	7
	Long-Trans.	462	407	6
	Short-Trans.	441	393	2
Over 101.6 to 127, incl	Longitudinal	455	400	6
	Long-Trans.	455	400	6
	Short-Trans.	434	379	2
Over 127 to 152.4, incl	Longitudinal	448	393	6
	Long-Trans.	448	386	5
	Short-Trans.	427	372	2

3.3.2 Stress-Corrosion Resistance

When specified, specimens as in 4.3.2 from plate 1.500 to 6.000 inches (38.10 to 152.40 mm), inclusive, in nominal thickness shall show no evidence of stress-corrosion cracking when stressed to 50% of the specified minimum long-transverse yield strength and tested in accordance with ASTM G47.

3.3.3 Fracture Toughness

For product 1.500 to 6.000 inches (38.10 to 152.40 mm) thick, plane-strain fracture toughness (K_{Ic}) shall be determined in accordance with ASTM E399 and ASTM B645 in the L-T specimen orientation and other orientations as specified by the purchaser. 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 specified in Table 3.

Table 3A - Minimum K_{Ic} or K_Q "usable for lot release" fracture toughness, inch/pound units

Nominal Thickness Inches	Specimen Orientation L - T	Specimen Orientation T - L	Specimen Orientation S - L
	$\text{ksi}\sqrt{\text{inch}}$	$\text{ksi}\sqrt{\text{inch}}$	$\text{ksi}\sqrt{\text{inch}}$
1.500 to 2.000, incl	26	23	19
Over 2.000 to 4.000, incl	26	22	20
Over 4.000 to 6.000, incl	25	21	21

Table 3B - Minimum K_{Ic} or K_Q "usable for lot release" fracture toughness, SI units

Nominal Thickness Millimeters	Specimen Orientation L - T	Specimen Orientation T - L	Specimen Orientation S - L
	$\text{MPa}\sqrt{\text{m}}$	$\text{MPa}\sqrt{\text{m}}$	$\text{MPa}\sqrt{\text{m}}$
38.10 to 50.80, incl	29	25	21
Over 50.80 to 101.60, incl	29	24	22
Over 101.60 to 152.40, incl	27	23	23

3.3.4 Mechanical property requirements for product outside the range covered by 1.1 shall be agreed upon between the purchaser and producer and reported per 4.4.1.

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 requirements for 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 the 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 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 plate conforms to specified requirements.

4.2 Classification of Tests

Composition (see 3.1), long-transverse tensile properties and, when specified, longitudinal and/or short-transverse tensile properties (see 3.3.1), stress-corrosion resistance (see 3.3.2) when specified, L-T fracture toughness and, when specified, T-L and S-L fracture toughness (see 3.3.3), ultrasonic soundness (see 3.4.1), and tolerances (see 3.5) are acceptance tests and, except for composition, shall be performed on each inspection lot.

4.3 Sampling and Testing

Shall be in accordance with AMS2355 and the following:

4.3.1 Tensile specimens shall be taken with the axis of specimens in the long-transverse direction and, when specified, in the longitudinal and/or short-transverse directions.

4.3.2 Specimens for stress-corrosion testing shall be taken parallel to the short-transverse grain direction from the center width of one or more plates from each inspection lot.

4.3.3 Specimens for fracture-toughness testing shall be taken from the center width of one or more plates in each inspection lot for each test direction specified.

4.4 Reports

The producer of sheet shall furnish with each shipment a report stating that the product conforms to the chemical composition, tolerances, and ultrasonic test requirements and showing numerical results of tests for the other acceptance test requirements. This report shall include the purchase order number, inspection lot number(s), AMS4221F, size, and quantity. The report shall also identify the producer, the product form, and the mill-produced size.