AEROSPACE MATERIAL SPECIFICATION

AMS4205	REV. D

Issued 1982-07
Reaffirmed 2007-11
Revised 2015-02

Superseding AMS4205C

Aluminum Alloy, Plate
6.2Zn - 1.8Cu - 2.4Mg - 0.13Zr (7010-T7451)
Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated
(Composition similar to UNS A97010)

RATIONALE

AMS4205D revises Title, Tensile Properties (3.3.1.1), Fracture Toughness (3.3.3, Tables 3A and 3B) Quality (Table 4), Acceptance Tests (4.2.1), Sampling and Testing (4.3.2.1 present in revision C has been deleted), and Reports (4.4.1), and is a Five Year Review and update of this specification.

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1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of plate up to 5.500 inches (139.70 mm), inclusive in thickness (See 8.4).

1.2 Application

This plate has been used typically for parts requiring higher tensile strength than AMS4203 (7010-T7351) and good resistance to stress-corrosion cracking, 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 724-776-4970 (outside USA, www.sae.org.

AMS2355 Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

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AS1990 Aluminum Alloy Tempers

AMS4203 Aluminum Alloy Plate, 6.2Zn - 1.8Cu - 2.4Mg - 0.13Zr (7010-T351), Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated

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 for Aerospace Applications

ASTM B660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B666/B666M Identification of Aluminum and Magnesium Alloy Products

ASTM E399 Linear-Elastic Plane-Strain Fracture Toughness K_{Ic} of Metallic Materials

ASTM E1304 Plane-Strain (Chevron-Notch) Fracture Toughness of Metallic Materials

ASTM G34 Exfoliation Corrosion Susceptibility in 2XXX and 7XXX Series Aluminum Alloys (EXCO Tests)

ASTM G47 Determining Susceptibility to Stress-Corrosion Cracking of High-Strength Aluminum Alloy Products

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, 4th Floor, New York, NY 10036, Tel: 212-642-4900, www.ansi.org.

ANSI H 35.2 Dimensional Tolerances for Aluminum Mill Products

ANSI H 35.2M 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	--	0.12
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	

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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 T7451 temper (See AS1990) 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 shown in Table 2.

3.3.1.1 Tensile properties of plate outside the size range listed in 1.1 shall be as agreed upon between purchaser and vendor.

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

Nominal Thickness Inches	Specimin Orientation	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 2.000, incl	Longitudinal	71.0	62.0	9
	Long-Trans.	72.0	62.0	6
Over 2.000 to 2.500, incl	Longitudinal	71.0	62.0	9
	Long-Trans.	72.0	62.0	6
	Short-Trans.	67.0	57.0	2.5
Over 2.500 to 4.000, incl	Longitudinal	70.0	61.0	9
	Long-Trans.	71.0	61.0	6
	Short-Trans.	66.0	56.0	2
Over 4.000 to 5.000, incl	Longitudinal	68.0	59.0	9
	Long-Trans.	69.0	59.0	5
	Short-Trans.	65.0	54.0	2
Over 5.000 to 5.500, incl	Longitudinal	66.0	57.0	8
	Long-Trans.	67.0	57.0	5
	Short-Trans.	63.0	53.0	2

Table 2B - Minimum tensile properties, SI units

Nominal Thickness Millimeters	Specimin Orientation	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 50.80, incl	Longitudinal	490	427	9
	Long-Trans.	496	427	6
Over 50.80 to 63.50, incl	Longitudinal	490	427	9
	Long-Trans.	496	427	6
	Short-Trans.	462	393	2.5
Over 63.50 to 101.60, incl	Longitudinal	483	421	9
	Long-Trans.	490	421	6
	Short-Trans.	455	386	2
Over 101.60 to 127.00, incl	Longitudinal	469	407	9
	Long-Trans.	476	407	5
	Short-Trans.	448	372	2
Over 127.00 to 139.70, incl	Longitudinal	455	393	8
	Long-Trans.	462	393	5
	Short-Trans.	434	365	2

3.3.2 Conductivity

Shall be not lower than 40.0% IACS (International Annealed Copper Standard) (23.2 MS/m), determined on specimens as in 4.3.1.

3.3.2.1 Plate not meeting the requirement of 3.3.2 may be given additional precipitation heat treatment. After such treatment, if the specified conductivity/property relationships conforming to 3.3.1 and 3.3.2 are met, the plate is acceptable.

3.3.3 Fracture Toughness

When specified for plate 2.000 to 5.500 inches (50.8 to 139.70 mm), inclusive in nominal thickness, plane strain fracture toughness shall be tested in accordance with ASTM E399 and ASTM B645. The required orientation(s) shall be specified by the purchaser. For the L-T and T-L test orientations, the test specimens shall meet the following requirements: For plate 2.000 to 4.000 inches (50.80 to 101.60 mm), inclusive, in nominal thickness, use 2-inch (51-mm) thick specimens centered at T/2. For plate over 4.000 inches (101.60 mm) and up through 5.500 inches (139.70 mm), use 2-inch (51-mm) thick specimen centered at T/4. For the S-L test orientation, use an 0.75-inch (19-mm) thick specimen or larger centered at T/2. It is recommended that the S-L specimen be the largest standard specimen size permitted by the plate gauge.

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 3A and 3B.

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

Nominal Thickness Inches	Test Direction	ksi √inch
2.000 to 5.500, incl	L-T	24
2.000 to 5.500, incl	T-L	22
Over 2.000 to 5.500, incl	S-L	20

Table 3B - Minimum K_{Ic} or K_q usable for lot release, SI units

Nominal Thickness Millimeters	Test Direction	MPa √mm
50.80 to 139.70, incl	L-T	26
50.80 to 139.70, incl	T-L	24
Over 50.80 to 139.70, incl	S-L	22

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 50% of the specified minimum long-transverse yield strength for plate 3 inches (76 mm) and under in nominal thickness and to 35.0 ksi (241 MPa) for plate over 3 inches (76 mm) in nominal thickness.

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.

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

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