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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 4090B

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Superseding AMS 4090A

ALUMINUM ALLOY PLATE
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T651)
Solution Heat Treated, Stress Relieved, and Precipitation Heat Treated

UNS A97475

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of plate.

1.2 Application: Primarily for structural applications requiring plate with high strength, moderate fatigue strength, and high fracture-toughness.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2202 - Tolerances, Aluminum Alloy and Magnesium Alloy Sheet and Plate
MAM 2202 - Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Sheet and Plate
AMS 2350 - Standards and Test Methods
AMS 2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings
MAM 2355 - Quality Assurance Sampling and Testing of Aluminum Alloys and Magnesium Alloys, Wrought Products (Except Forging Stock) and Flash Welded Rings, Metric (SI) Units

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B594 - Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications
ASTM E338 - Sharp-Notch Tension Testing of High-Strength Sheet Materials
ASTM E602 - Sharp-Notch Tension Testing with Cylindrical Specimens

Printed in U.S.A.

REAFFIRMED
10-91, 5/95

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Table Avenue, Philadelphia, PA 19120.

2.3.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

2.3.2 Military Standards:

MIL-STD-649 - Aluminum and Magnesium Products, Preparation for Shipment and Storage

2.4 ANSI Publications: Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Texture

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined in accordance with AMS 2355 or MAM 2355:

	min	max
Zinc	5.2	6.2
Magnesium	1.9	2.6
Copper	1.2	1.9
Chromium	0.18	0.25
Iron	--	0.12
Silicon	--	0.10
Manganese	--	0.06
Titanium	--	0.06
Other Impurities, each	--	0.05
Other Impurities, 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; furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-6088.

3.2.1 Plate shall receive no straightening operations after stretching.

3.3 Properties: Plate shall conform to the following requirements, determined in accordance with AMS 2355 or MAM 2355:

3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.1.
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Table I

Nominal Thickness Inches	Specimen Orientation	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
0.250 to 0.499, incl	Longitudinal	77,000	69,000	10
	Long Transverse	78,000	67,000	10
Over 0.499 to 1.500, incl	Longitudinal	77,000	70,000	9
	Long Transverse	78,000	68,000	9

Table I (SI)

Nominal Thickness Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
6.25 to 12.50, incl	Longitudinal	530	475	10
	Long Transverse	540	460	10
Over 12.50 to 37.50, incl	Longitudinal	530	485	9
	Long Transverse	540	470	9

3.3.1.1 Tensile property requirements for plate over 1.500 in. (37.50 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.3.2 Fracture Toughness: Plane-strain fracture toughness (K_{Ic}) shall be not lower than the values specified in Table II. Tests shall be conducted in both L-T and T-L directions on the first production lot shipped to the purchaser; tests in the L-T direction shall be performed on subsequent lots, unless otherwise specified.
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Table II

Specimen Orientation (See 8.4)	K_{Ic} ksi $\sqrt{in.}$	K_{Ic} MPa $\sqrt{m}$
L-T	30	33
T-L	28	31

3.3.3 Notch Tensile Strength/Tensile Yield Strength (NTS/TYS) Ratio: The producer may guarantee that plate meets the fracture toughness (K_{Ic}) requirements based on correlation with notch tensile strength/tensile yield strength (NTS/TYS) ratio in lieu of determining fracture toughness provided that he has established correlation between the two tests for his plate.

3.3.3.1 Notch tensile strength shall be determined in accordance with ASTM E338 Ø except that specimens for plate 0.250 to 0.750 in. (6.25 to 18.75 mm), excl, in nominal thickness shall conform to Fig. 1 of this specification and for plate 0.750 in. (18.75 mm) and over in nominal thickness specimens shall conform to Fig. 2 of this specification except that for plate 1.250 to 1.500 in. (31.25 to 37.50 mm) in nominal thickness a 1.060 in. (27 mm) notched cylindrical specimen in accordance with ASTM E602 may be used (See 8.3). Notch tensile tests shall be made in both the longitudinal and long-transverse directions, and the notch tensile strength values determined for each direction shall be divided by the tensile strength determined for the same direction to obtain NTS/TYS ratios.

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 When specified, each plate shall be ultrasonically inspected in accordance with ASTM B594 and shall meet ultrasonic Class B.

3.5 Tolerances: Shall conform to all applicable requirements of AMS 2202 or MAM 2202.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of plate shall supply all samples Ø for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the plate conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot except that fracture toughness need not be determined if the notch tensile strength/tensile yield strength ratio indicates that the established correlation is met.

4.3 Sampling: Shall be in accordance with AMS 2355 or MAM 2355. Ø

4.3.1 Sampling for notch tensile strength/tensile yield strength ratio shall be Ø as agreed upon by purchaser and vendor and shall be from the full section thickness of one plate from each lot.

4.4 Reports:

4.4.1 The vendor of plate shall furnish with each shipment a report stating that the plate conforms to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, lot number, AMS 4090B, size, and quantity.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 4090B, contractor or other direct supplier of plate, part number, and quantity. When plate for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of plate to determine conformance to the requirements of this specification and shall include in the report either a statement that the plate conforms or copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2355 or MAM 2355.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each plate shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4090, inspection lot number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be legible, shall be applied using a suitable marking fluid, and shall be sufficiently stable to withstand normal handling. The markings shall have no deleterious effect on the plate or its performance.

5.1.1 Plate Under 6 In. (150 mm) Wide: Shall be marked in one or more rows of characters recurring at intervals not greater than 3 ft (900 mm). The inspection lot number may appear in the row marking or may appear at only one location on each plate.

5.1.2 Flat Plate 0.375 In. (9.50 mm) and Under Thick, 6 - 60 In. (150 - 1500 mm), Incl, Wide, and 36 - 200 In. (900 - 5000 mm), Incl, Long: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (900 mm), the rows being spaced approximately 6 in. (150 mm) on centers across the width and staggered. Every third row shall show the manufacturer's identification and nominal thickness. The other rows shall show the alloy number and temper and AMS 4090. The inspection lot number may be included in the rows with the alloy number and temper and specification designation or may appear at only one location on each plate.

5.1.3 Flat Plate Over 0.375 In. (9.50 mm) Thick, or Over 60 In. (1500 mm) Wide, or Over 200 In. (5000 mm) Long: Shall be marked as in 5.1.2 or, at vendor's discretion, shall be marked in one or two rows of characters recurring at intervals not greater than 3 ft (900 mm) and running around the periphery of the piece. If one row is used, it shall show all information of 5.1 except that the inspection lot number may be omitted. If two rows are used, one row shall show the alloy number and temper and AMS 4090; the second row shall show the manufacturer's identification and nominal thickness. The inspection lot number may be included in the line with the manufacturer's identification and nominal thickness or may appear at only one location on each plate.

5.1.3.1 If peripheral marking is applied to the full plate as produced but partial plates are supplied, an arrow shall also be applied near one corner indicating the direcion of rolling.

5.2 Protective Treatment: Flat plate shall be protected, during shipment and storage, by interleaving with suitable paper sheets.

5.3 Packaging:

5.3.1 Plate shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the plate to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.3.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-649, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.3.1 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Plate not conforming to this specification or to modifications authorized by purchaser wil be subject to rejection.

8. NOTES:

8.1 Marginal Indicia: The phi (Ø) symbol is used to indicate technical changes from the previous issue of this specification.

8.2 Dimensions and properties in inch/pound units are primary; dimensions and properties in SI units are shown as the approximate equivalents of the inch/pound units and are presented only for information.

8.3 The notch tensile strength is directly dependent upon specimen shape and thickness so it is imperative that the geometry shown in Figs. 1 and 2 be used. In addition, the results of notch tensile tests are extremely susceptible to misalignment and every effort should be made to control alignment.

8.4 Specimen Orientation for Fracture Toughness Tests: L-T stress is applied in the longitudinal grain direction with crack propagating in the long-transverse grain direction and T-L stress is applied in the long-transverse grain direction with crack propagating in the longitudinal direction.

8.5 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Size of plate desired
Quantity of plate desired
Applicable level of packaging (See 5.3.2)

8.6 Plate meeting the requirements of this specification has been classified under Federal Supply Classification (FSC) 9535.

This specification is under the jurisdiction of AMS Committee "D".