Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 4090

Issued 1-15-76
Revised

UNS A97475

ALUMINUM ALLOY, PLATE
5.7Zn - 2.2Mg - 1.6Cu - 0.22Cr (7475-T651)

1. SCOPE:

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

1.2 Application: Primarily for structural applications requiring material 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 (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

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

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

ASTM E338 - Sharp-Notch Tension Testing of High-Strength Sheet Materials
ASTM E399 - Plane-Strain Fracture Toughness of Metallic Materials

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

2.3.1 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:

Printed in U.S.A.

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

3.2.1 Plate shall receive no further straightening operations after stretching.

3.3 Properties: The product shall conform to the following requirements:

3.3.1 Tensile Properties: Shall be as specified in Table I and 3.3.1.2, determined in accordance with AMS 2355.

3.3.1.1 Plate 1.500 In. (38.10 mm) and Under in Nominal Thickness:

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	67,000	9
	Long Transverse	78,000	67,000	9
Over 0.499 to 1.000, incl	Longitudinal	77,000	68,000	8
	Long Transverse	78,000	68,000	8
Over 1.000 to 1.500, incl	Longitudinal	76,000	67,000	6
	Long Transverse	77,000	67,000	6

TABLE I (SI)

Nominal Thickness Millimetres	Specimen Orientation	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min
6.35 to 12.67, incl	Longitudinal	531	462	9
	Long Transverse	538	462	9
Over 12.67 to 25.40, incl	Longitudinal	531	469	8
	Long Transverse	538	469	8
Over 25.40 to 38.10, incl	Longitudinal	524	462	6
	Long Transverse	531	462	6

3.3.1.2 Plate Over 1.500 In. (38.10 mm) in Nominal Thickness: As agreed upon by purchaser and vendor.

3.3.2 Notch Tensile/Tensile Yield Strength Ratio: The notch tensile strength/tensile yield strength (NTS/TYS) ratio, determined in accordance with 3.3.2.1, shall be not lower than the values shown in Table II.

TABLE II

Nominal Thickness		Specimen Orientation	NTS/TYS Ratio
Inches	(Millimetres)		
0.250 to 0.500, incl	(6.35 to 12.70, incl)	Longitudinal	0.65
		Long Transverse	0.65
Over 0.500 to 0.749, incl	(Over 12.70 to 19.02, incl)	Longitudinal	0.60
		Long Transverse	0.60
Over 0.749 to 1.500, incl	(Over 19.02 to 38.10, incl)	Longitudinal	1.35
		Long Transverse	1.30

3.3.2.1 For plate 0.250 to 0.749 in. (6.35 to 19.02 mm), incl, in nominal thickness, notch tensile strength shall be determined in accordance with ASTM E338 on specimens in the longitudinal and long transverse direction; the specimens shall conform to Fig. 1. For plate over 0.749 in. (19.02 mm) in nominal thickness, notch tensile strength shall be determined in accordance with a procedure, based on ASTM E338, agreed upon by purchaser and vendor on specimens in the longitudinal and long transverse direction; the specimens shall conform to Fig. 2 (See 8.2). The values for each direction shall be divided by the determination of tensile yield strength in the same direction to obtain NTS/TYS ratios.

3.3.3 Fracture Toughness: If the product fails to meet the requirements of 3.3.2, the product will be considered acceptable if the plane-strain fracture toughness (K_{Ic}), determined in accordance with 3.3.3.1, is not lower than the values specified in Table III.

TABLE III

Specimen Orientation (See 8.3)	K_{Ic}	
	ksi $\sqrt{in.}$	(MPa $\sqrt{m}$)
LT	30	33
TL	28	31

3.3.3.1 Fracture toughness shall be determined in accordance with ASTM E399. The LT and TL specimens of the standard proportions shown in ASTM E399 shall have crack length of not less than 1.50 in. (38.1 mm) (i.e., W = 3.00 in (76.2 mm), and be full thickness. If the test results are above the specified minimum values but are invalid because of insufficient thickness or excess plasticity as indicated by the P_{max}/P_Q ratio, the fracture toughness of the product is acceptable.

3.4 Quality: The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2202.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples 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 perform such confirmatory testing as he deems necessary to ensure that the product 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 or routine control tests except that fracture toughness need not be determined if the notch tensile/tensile yield strength ratio requirements are met.

4.3 Sampling: Shall be in accordance with AMS 2355 and the following; an inspection lot shall be all product of the same alloy, temper, section, and size traceable to a heat treatment lot and subjected to vendor's inspection at one time.

4.3.1 Sampling for notch tensile/tensile yield strength ratio and fracture toughness shall be as agreed upon by purchaser and vendor.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report stating that the product conforms to the chemical composition and other technical requirements of this specification. This report shall include the purchase order number, material specification number, size, and quantity.

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

4.5 Resampling and Retesting: Shall be in accordance with AMS 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 clearly 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 material or its performance.

5.1.1 Plate Under 6 In. (152 mm) Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm). The inspection lot number may appear in the row marking or may appear at only one location on the piece.

5.1.2 Flat Plate 0.375 In. (9.52 mm) and Under Thick, 6 - 60 In. (152 - 1524 mm), Incl, Wide, and 36 - 200 In. (914 - 5080 mm), Incl, Long: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm), the rows being spaced approximately 6 in. (152 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 piece.

5.1.3 Flat Plate Over 0.375 In. (9.52 mm) Thick, or Over 60 In. (1524 mm) Wide or Over 200 In. (5080 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 (914 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 piece.

5.1.3.1 If peripheral marking is applied to the full piece as produced but partial plates are supplied, an arrow shall also be applied near one corner indicating the direction 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 The product shall be prepared for shipment in accordance with commercial practice to ensure carrier acceptance and safe transportation to the point of 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 in all quotations and when acknowledging purchase orders.

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

8. NOTES:

8.1 The dimensions and properties in U.S. conventional units are primary; dimensions and properties in SI units are the equivalent of U.S. conventional units and are not to be construed as standard for product produced to SI dimensions.

8.2 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.

8.3 Specimen Orientation for Fracture Toughness Tests: LT stress is applied in the longitudinal grain direction with crack propagating in the long transverse grain direction and TL stress is applied in the long transverse grain direction with crack propagating in the longitudinal direction.

8.4 For direct U.S. Military procurement, purchase documents should specify the following:

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