

AEROSPACE MATERIAL SPECIFICATION

SAE MAM-4209

**REV
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Superseding MAM-4209

Submitted for recognition as an American National Standard

ALUMINUM ALLOY SHEET, ALCLAD
6.0Cu - 0.40Zr (2004-F)
As Rolled

UNS A82004

1. SCOPE:

1.1 Form: This specification covers an aluminum alloy in the form of sheet procured in metric units.

1.1.1 AMS-4209 is the inch/pound version of this MAM.

1.2 Application: Primarily for parts requiring a high degree of formability (superplasticity) and response to heat treatment.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

MAM-2202 - Tolerances, Metric, Aluminum Alloy and Magnesium Alloy Sheet and Plate

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

AMS-2811 - Identification, Aluminum and Magnesium Alloy Wrought Products

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- 2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM B 660 - Packaging/Packing of Aluminum and Magnesium Products
 ASTM E 21 - Elevated Temperature Tension Tests of Metallic Materials

3. TECHNICAL REQUIREMENTS:

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

Core			Cladding		
	min	max		min	max
Copper	5.5	6.5	Aluminum	99.7	--
Zirconium	0.30	0.50	Silicon	--	0.20
Magnesium	--	0.50	Iron	--	0.20
Silicon	--	0.20	Copper	--	0.07
Iron	--	0.20	Other Impurities, each	--	0.05
Manganese	--	0.10	Other Impurities, total	--	0.15
Zinc	--	0.10			
Titanium	--	0.05			
Other Impurities, each	--	0.05			
Other Impurities, total	--	0.15			
Aluminum	remainder				

- 3.2 Condition: As-rolled (-F temper). Sheet shall not be flattened, leveled, or straightened.

- 3.3 Properties: Sheet shall conform to the following requirements, determined in accordance with MAM-2355 except as specified in 3.3.1:

- 3.3.1 As-Rolled (Superplasticity): Specimens, conforming to Figure 1, shall have the following properties after being heated to $450^{\circ}\text{C} \pm 5$, held at heat for 20 - 30 minutes before testing, and tested in accordance with ASTM E 21 at $450^{\circ}\text{C} \pm 5$ using a constant crosshead speed of 12.5 mm per minute.

Elongation in 12.5 mm, minimum	
Individual Test	250%
Average of All Tests	300%

- 3.3.2 As Pseudo-Formed: Sheet shall have the following properties after being heated to $450^{\circ}\text{C} \pm 5$, held at heat for 20 minutes ± 2 , and cooled in air:

Tensile Strength	200 - 255 MPa
Yield Strength at 0.2% Offset	90 - 150 MPa
Elongation in 50 mm	10 - 20%

3.3.3 After Solution and Precipitation Heat Treatment: Sheet shall have the following properties after being solution heat treated by heating to $530^{\circ}\text{C} \pm 5$, holding at heat for 30 - 60 minutes, and quenching in warm (approximately 40°C) water, with quenching being completed within 20 seconds, and precipitation heat treated by heating to $165^{\circ}\text{C} \pm 5$, holding at heat for 16 - 20 hours, and cooling in air or, when permitted by purchaser, heating to $185^{\circ}\text{C} \pm 5$, holding at heat for 3.5 - 5 hours, and cooling in air:

Tensile Strength	350 - 450 MPa
Yield Strength at 0.2% Offset	230 - 310 MPa
Elongation in 50 mm	8 - 20%

3.3.4 Cladding Thickness: Shall be uniform on both sides of the sheet; the average thickness on each side shall be not less than 6% of the total sheet thickness.

3.4 Quality: Sheet, 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 sheet.

3.4.1 Edge Cracking: Shall be absent.

3.5 Tolerances: Shall be as follows:

3.5.1 Thickness: Shall conform to all applicable requirements of MAM-2202.

3.5.2 Length and Width: ± 12.5 millimetres.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of sheet shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the sheet conforms to the requirements of this specification.

4.2 Classification of Tests: Tests for all technical requirements are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing: Shall be in accordance with MAM-2355 and the following; a lot shall be all sheet produced from one ingot processed and rolled to the same nominal thickness in one series of operations:

4.3.1 Specimens for as-rolled (superplasticity) elongation (3.3.1) shall be taken and tested in duplicate in the longitudinal direction and also in the transverse direction from sheet 55 mm and over in nominal width.

4.4 Reports: The vendor of sheet shall furnish with each shipment a report stating that the sheet conforms to the chemical composition and other technical requirements. This report shall include the purchase order number, lot number, MAM-4209A, size, and quantity.

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

5. PREPARATION FOR DELIVERY:

5.1 Identification: Shall be in accordance with AMS-2811.

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5.2 Protective Treatment: Flat sheet shall be protected, during shipment and storage, by interleaving with suitable paper sheets. Sheet shall not be oiled.

5.3 Packaging:

5.3.1 Each lot shall be packaged separately.

5.3.2 Sheet 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 sheet to ensure carrier acceptance and safe delivery.

5.3.3 For direct U.S. Military procurement, packaging shall be in accordance with ASTM B 660, Commercial Level, unless Level A is specified in the request for procurement.

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

7. REJECTIONS: Sheet not conforming to this specification, or to modifications authorized by purchaser, will 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 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification
Size of sheet desired
Quantity of sheet desired
Level A packaging, if required (See 5.3.3).

8.3 Sheet 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".