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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4209

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

1. SCOPE:

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

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 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
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

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

ASTM E21 - Elevated Temperature Tension Tests of Metallic Materials

2.3 U.S. 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

3. TECHNICAL REQUIREMENTS:

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

Core	min	max	Cladding	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 AMS 2355 except as specified in 3.3.1:

3.3.1 As-Rolled (Superplasticity): Specimens, conforming to Fig. 1, shall have the following properties after being heated to 840°F ± 10, held at heat for 20 - 30 min. before testing, and tested in accordance with ASTM E21 at 840°F ± 10 using a constant crosshead speed of 0.5 in. per minute.

Elongation in 0.5 in., min	
Individual Test	250%
Average of All Tests	300%

3.3.2 As Pseudo-Formed: Sheet shall have the following properties after being heated to 840°F ± 10, held at heat for 20 min. ± 2, and cooled in air:

Tensile Strength	29,000 - 37,000 psi
Yield Strength at 0.2% Offset	13,000 - 22,000 psi
Elongation in 2 in.	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 985°F ± 10, holding at heat for 30 - 60 min., and quenching in warm (approximately 105°F) water, with quenching being completed within 20 sec, and precipitation heat treated by heating to 330°F ± 10, holding at heat for 16 - 20 hr, and cooling in air or, when permitted by purchaser, heating to 365°F ± 10, holding at heat for 3.5 - 5 hr, and cooling in air:

Tensile Strength	51,000 - 65,000 psi
Yield Strength at 0.2% Offset	33,000 - 45,000 psi
Elongation in 2 in.	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.

3.5 Tolerances: Shall be as follows:

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

3.5.2 Length and Width: ± 0.5 inch.

3.5.3 Edge Cracking: Shall be absent.

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. 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 sheet 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.

4.3 Sampling: Shall be in accordance with AMS 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 in duplicate in the longitudinal direction and in the transverse direction from sheet 2.25 in. and over in nominal width.

4.4 Reports:

4.4.1 The vendor of sheet shall furnish with each shipment a report stating that the sheet conforms to the chemical composition and other technical reqirements of this specification. This report shall include the purchase order number, AMS 4209, lot number, 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 4209, contractor or other direct supplier of sheet, part number, and quantity. When sheet for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of sheet to determine conformance to the requirements of this specification and shall include in the report either a statement that the sheet 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.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each sheet shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4209, 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 sheet or its performance.

5.1.1 Flat Sheet Under 6 In. Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 feet. The lot number may appear in the row marking or may appear at only one location on each piece.

5.1.2 Flat Sheet 6 - 60 In., Incl, Wide and 36 - 200 In., Incl, Long: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft, the rows being spaced approximately 6 in. 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 4209. The lot number may be included in the rows with the alloy number, temper, and specification designations or may appear at only one location on each piece.

5.1.3 Flat Sheet Over 60 In. Wide or Over 200 In. 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 and running around the periphery of the piece. If one row is used, it shall show all information of 5.1 except that the lot number may be omitted. If two rows are used, one row shall show the alloy number and temper and AMS 4209; the second row shall show the manufacturer's identification and nominal thickness. The 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.