

AEROSPACE MATERIAL SPECIFICATION

Issued JUL 1985
Revised SEP 2005
Superseding AMS 4209A

Aluminum Alloy Sheet, Alclad
6.0Cu - 0.40Zr - (2004-F)
As Rolled

(Composition similar to UNS A82004)

1. SCOPE:

1.1 Form:

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

1.2 Application:

This product has been used typically for parts requiring a high degree of formability (super-plasticity) and response to heat treatment, 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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2355 Quality Assurance Sampling and Testing, Aluminum Alloys and Magnesium Alloys, Wrought Products, Except Forging Stock, and Rolled, Forged, or Flash Welded Rings

AS1990 Aluminum Alloy Tempers

SAE Technical Standards Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any patent infringement arising therefrom, is the sole responsibility of the user."

SAE reviews each technical report at least every five years at which time it may be reaffirmed, revised, or cancelled. SAE invites your written comments and suggestions.

Copyright © 2005 SAE International

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without the prior written permission of SAE.

TO PLACE A DOCUMENT ORDER:

Tel: 877-606-7323 (inside USA and Canada)
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: custsvc@sae.org
<http://www.sae.org>

SAE WEB ADDRESS:

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 21	Elevated Temperature Tension Tests of Metallic Materials
ASTM B 660	Packaging/Packing of Aluminum and Magnesium Products
ASTM B 666/B 666M	Identification Marking of Aluminum and Magnesium Products

2.3 ANSI Publications:

Available from ANSI, 25 West 43rd Street, New York, NY 10036 or 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 following percentages by weight, shown in Tables 1 and 2, determined in accordance with AMS 2355:

TABLE 1 - Composition, Core (2004-F)

Element	min	max
Silicon	--	0.20
Iron	--	0.20
Copper	5.5	6.5
Manganese	--	0.10
Magnesium	--	0.50
Zinc	--	0.10
Titanium	--	0.05
Zirconium	0.30	0.50
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

TABLE 2 - Cladding

Element	min	max
Aluminum	97.7	--
Silicon	--	0.20
Iron	--	0.20
Copper	--	0.07
Other Elements, each	--	0.05
Other Elements, each	--	0.15

3.2 Condition:

As-rolled to the -F temper (See AS1990). Sheet shall not be flattened, leveled, or straightened.

3.3 Properties:

Sheet shall conform to the following requirements, determined in accordance with AMS 2355 on the mill product size, except as specified in 3.3.1:

- 3.3.1 As-Rolled (Super-plasticity): Specimens, conforming to Figure 1, shall have the properties shown in Table 3 after being heated to $840^{\circ}\text{F} \pm 10$ ($450^{\circ}\text{C} \pm 6$), held at heat for 20 to 30 minutes before testing, and tested in accordance with ASTM E 21 at $840^{\circ}\text{F} \pm 10$ ($450^{\circ}\text{C} \pm 6$) using a constant crosshead speed of 0.5 inch per minute (12.5 mm/minute).

TABLE 3 - Minimum As-Rolled Elongation

Property	Value
Elongation in 0.5 inch (12.7 mm)	
Individual Tests	250%
Average of All Tests	300%

- 3.3.2 Pseudo As-Formed: Sheet shall have the room temperature properties shown in Table 4 after being heated to $840^{\circ}\text{F} \pm 10$ ($450^{\circ}\text{C} \pm 6$), held at heat for 20 minutes ± 2 , and cooled in air:

TABLE 4 - Tensile Properties (Pseudo As-Formed)

Property	Value
Tensile Strength	29.0 to 37.0 ksi (200 to 255 MPa)
Yield Strength at 0.2% Offset	13.0 to 22.0 ksi (90 to 152 MPa)
Elongation in 2 Inches (50.8 mm)	10% to 20%

- 3.3.3 Response to Heat Treatment: Sheet shall have the properties shown in Table 5 after being solution heat treated by heating to $985^{\circ}\text{F} \pm 10$ ($529^{\circ}\text{C} \pm 6$), holding at heat for 30 to 60 minutes, and quenching in warm (approximately 105°F (41°C)) water, with quenching being completed within 20 seconds, and precipitation heat treated by heating to $330^{\circ}\text{F} \pm 10$ ($166^{\circ}\text{C} \pm 6$), holding at heat for 16 to 20 hours, and cooling in air or, when permitted by purchaser, heating to $365^{\circ}\text{F} \pm 10$ ($185^{\circ}\text{C} \pm 6$), holding at heat for 3.5 to 5 hours, and cooling in air:

TABLE 5 - Tensile Properties After Solution and Precipitation Heat Treatment

Property	Value
Tensile Strength	51.0 to 65.0 ksi (352 to 448 MPa)
Yield Strength at 0.2% Offset	33.0 to 45.0 ksi (228 to 310 MPa)
Elongation in 2 Inches (50.8 mm)	8% to 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, free from foreign materials and free from edge cracking and any 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 ANSI H 35.2 or ANSI H 35.2M.

3.5.2 Length and Width: ± 0.5 inch (± 12.7 mm).

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the sheet conforms to specified requirements.

4.2 Classification of Tests:

All technical requirements are acceptance tests and, except for composition, shall be performed on each lot.

4.3 Sampling and Testing:

Shall be in accordance with AMS 2355 and the following:

4.3.1 A lot shall be all sheet produced from one ingot processed and rolled to the same nominal thickness in one series of operations.

4.3.2 Specimens for as-rolled (super-plasticity) elongation (3.3.1) shall be taken and tested in duplicate in the longitudinal direction and also in transverse direction from sheet 2.25 inches (57.1 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 composition, and shall include the numerical values of mechanical properties. The report shall also show conformance to the other technical requirements and shall include the purchase order number, lot number, AMS 4209B, size, and quantity. This report shall also identify the producer, product form, and the size of the mill product.

4.5 Resampling and Retesting:

Shall be in accordance with AMS 2355.

5. PREPARATION FOR DELIVERY:

5.1 Identification:

Shall be in accordance with ASTM B 666/B 666M.

5.2 Protective Treatment:

Product shall be protected from damage during storage and shipment by a method determined by vendor unless specified by purchaser. An example of a typical protective method includes, but is not limited to, interleaving with paper.

PRODUCT PRODUCED UNDER THIS SPECIFICATION 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 ASTM B 660 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.

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 A change bar (|) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this specification. An (R) symbol to the left of the document title indicates a complete revision of the specification, including technical revisions. Change bars and (R) are not used in original publications, nor in specifications that contain editorial changes only.

8.2 Terms used in AMS are clarified in ARP1917.

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

8.4 Purchase documents should specify not less than the following:

AMS 4209B

Size of sheet desired

Quantity of sheet desired.

8.5 Key Words:

Aluminum alloy sheet alclad, Alloy 2004-F, as rolled, UNS A82004, high formability, super-plasticity, response to heat treatment

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "D"