

**AEROSPACE  
MATERIAL  
SPECIFICATION**

**AMS 4051E**  
Superseding AMS 4051D

Issued 3-1-55  
Revised 4-1-85

ALUMINUM ALLOY SHEET AND PLATE, ALCLAD  
6.8Zn - 2.8Mg - 2.0Cu - 0.23Cr (Alclad 7178-0)  
Annealed

UNS A97178

1. SCOPE:

- 1.1 Form: This specification covers an aluminum alloy in the form of sheet and plate.
- 1.2 Application: Primarily for structural use, including machine tapered parts. Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking after heat treatment; ARP 823 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications and Aerospace Recommended Practices 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  
AMS 2770 - Heat Treatment of Aluminum Alloy Parts

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## 2.1.2 Aerospace Recommended Practices:

ARP 823 - Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

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

### 2.2.1 Military Specifications:

MIL-H-6088 - Heat Treatment of Aluminum Alloys

### 2.2.2 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 or MAM 2355:

| Core (7178)             |           |      | Cladding (7072)         |           |      |
|-------------------------|-----------|------|-------------------------|-----------|------|
|                         | min       | max  |                         | min       | max  |
| Zinc                    | 6.3       | 7.3  | Zinc                    | 0.8       | 1.3  |
| Magnesium               | 2.4       | 3.1  | Silicon + Iron          | --        | 0.7  |
| Copper                  | 1.6       | 2.4  | Copper                  | --        | 0.10 |
| Chromium                | 0.18      | 0.28 | Magnesium               | --        | 0.10 |
| Iron                    | --        | 0.50 | Manganese               | --        | 0.10 |
| Silicon                 | --        | 0.40 | Other Impurities, each  | --        | 0.05 |
| Manganese               | --        | 0.30 | Other Impurities, total | --        | 0.15 |
| Titanium                | --        | 0.20 | Aluminum                | remainder |      |
| Other Impurities, each  | --        | 0.05 |                         |           |      |
| Other Impurities, total | --        | 0.15 |                         |           |      |
| Aluminum                | remainder |      |                         |           |      |

### 3.2 Condition: Annealed in accordance with MIL-H-6088.

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

#### 3.3.1 As Annealed:

3.3.1.1 Tensile Properties:TABLE I

| Nominal<br>Thickness<br>Inch | Tensile<br>Strength<br>psi, max | Yield Strength<br>at 0.2% Offset<br>psi, max | Elongation<br>in 2 in. or 4D<br>%, min |
|------------------------------|---------------------------------|----------------------------------------------|----------------------------------------|
| 0.015 to 0.062, incl         | 36,000                          | 20,000                                       | 10                                     |
| Over 0.062 to 0.187, incl    | 38,000                          | 20,000                                       | 10                                     |
| Over 0.187 to 0.500, excl    | 40,000                          | 21,000                                       | 10                                     |
| 0.500                        | 40,000                          | --                                           | 10                                     |

TABLE I (SI)

| Nominal<br>Thickness<br>Millimetres | Tensile<br>Strength<br>MPa, max | Yield Strength<br>at 0.2% Offset<br>MPa, max | Elongation<br>in 50 mm or 4D<br>%, min |
|-------------------------------------|---------------------------------|----------------------------------------------|----------------------------------------|
| Over 0.40 to 1.60, incl             | 250                             | 140                                          | 10                                     |
| Over 1.60 to 4.00, incl             | 265                             | 140                                          | 10                                     |
| Over 4.00 to 12.50, incl            | 275                             | 145                                          | 10                                     |
| Over 12.50 to 12.70, incl           | 275                             | --                                           | 10                                     |

3.3.1.1.1 Tensile property requirements for plate over 0.500 in. (12.70 mm) thick shall be as agreed upon by purchaser and vendor.

3.3.2 After Solution and Precipitation Heat Treatment: The product, as received by purchaser, shall have the following properties after solution and precipitation heat treatment in accordance with AMS 2770 to the -T62 temper.

3.3.2.1 Tensile Properties:TABLE II

| Nominal<br>Thickness<br>Inch | Tensile<br>Strength<br>psi, min | Yield Strength<br>at 0.2% Offset<br>psi, min | Elongation<br>in 2 in. or 4D<br>%, min |
|------------------------------|---------------------------------|----------------------------------------------|----------------------------------------|
| 0.015 to 0.044, incl         | 76,000                          | 66,000                                       | 7                                      |
| Over 0.044 to 0.062, incl    | 78,000                          | 68,000                                       | 8                                      |
| Over 0.062 to 0.187, incl    | 80,000                          | 70,000                                       | 8                                      |
| Over 0.187 to 0.500, excl    | 82,000                          | 71,000                                       | 8                                      |
| 0.500                        | 84,000                          | 73,000                                       | 6                                      |

## 3.3.2.1 (Continued):

TABLE II (SI)

| Nominal Thickness<br>Millimetres | Tensile Strength<br>MPa, min | Yield Strength<br>at 0.2% Offset<br>MPa, min | Elongation<br>in 50 mm or 4D<br>%, min |
|----------------------------------|------------------------------|----------------------------------------------|----------------------------------------|
| Over 0.40 to 1.20, incl          | 525                          | 455                                          | 7                                      |
| Over 1.20 to 1.60, incl          | 540                          | 470                                          | 8                                      |
| Over 1.60 to 4.00, incl          | 550                          | 480                                          | 8                                      |
| Over 4.00 to 12.50, incl         | 565                          | 490                                          | 8                                      |
| Over 12.50 to 12.70, incl        | 580                          | 505                                          | 6                                      |

3.3.2.1.1 Tensile property requirements for plate over 0.500 in. (12.70 mm) thick shall be as agreed upon by purchaser and vendor.

3.3.3 Cladding Thickness: After rolling, the average cladding thickness shall conform to the requirements shown in Table III.

TABLE III

| Nominal Thickness         |                           | Cladding Thickness per Side<br>% of Total Thickness |     |
|---------------------------|---------------------------|-----------------------------------------------------|-----|
| Inches                    | Millimetres               | min                                                 | max |
| 0.015 to 0.062, incl      | 0.40 to 1.60, incl        | 3.2                                                 | -   |
| Over 0.062 to 0.187, incl | Over 1.60 to 4.00, incl   | 2                                                   | -   |
| Over 0.187 to 0.500, excl | Over 4.00 to 12.50, incl  | 1.2                                                 | -   |
| 0.500                     | Over 12.50 to 12.70, incl | 1.2                                                 | 3   |

3.4 Quality: The product, 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 product.

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 the product 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 product conforms to the requirements of this specification.

#### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties as annealed (3.3.1.1) and after solution and precipitation heat treatment (3.3.2.1), and tolerances (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for cladding thickness (3.3.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

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

#### 4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment a report stating that the product conforms to the chemical composition and to the other technical requirements of this specification. This report shall include the purchase order number, AMS 4051E, 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 4051E, 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 either a statement that the material 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 sheet and plate shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4051, 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 product or its performance.

5.1.1 Flat Sheet and Plate Under 6 In. (150 mm) Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (900 mm).