



# AEROSPACE MATERIAL SPECIFICATION

## AMS 4022D

Superseding AMS 4022C

Society of Automotive Engineers, Inc.  
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 1000

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ALUMINUM ALLOY SHEET AND PLATE, ALCLAD  
1.0Mg - 0.60Si - 0.30Cu - 0.25Cr (Alclad 6061; -T4 Sheet, -T451 Plate)

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.
2. **APPLICATION:** Primarily for formed, low strength, structural parts which may be subsequently precipitation heat treated and which are required to exhibit maximum corrosion resistance and to approximate the color and appearance of other clad aluminum alloy parts.
3. **COMPOSITION:**

	Core (6061)			Cladding (7072)	
	min	max		min	max
Magnesium	0.8	- 1.2	Zinc	0.8	- 1.3
Silicon	0.40	- 0.8	Silicon + Iron	--	0.7
Copper	0.15	- 0.40	Magnesium	--	0.10
Chromium	0.15	- 0.35	Copper	--	0.10
Iron	--	0.7	Manganese	--	0.10
Zinc	--	0.25	Other Impurities, each	--	0.05
Manganese	--	0.15	Other Impurities, total	--	0.15
Titanium	--	0.15	Aluminum		remainder
Other Impurities, each	--	0.05			
Other Impurities, total	--	0.15			
Aluminum		remainder			

4. **CONDITION:**
  - 4.1 **Sheet:** Solution heat treated.
  - 4.2 **Plate:** Solution heat treated and stretched to produce a nominal permanent set of 2% but not less than 1-1/2% nor more than 3%.
    - Ø 4.2.1 Plate shall receive no further straightening operations after stretching.
5. **TECHNICAL REQUIREMENTS:** The product shall conform to the following requirements; tensile properties shall be determined in accordance with the latest issue of AMS 2355.
  - 5.1 **Cladding Thickness:** After rolling, the average cladding thickness per side shall be not less than 4% of the total composite thickness. Routine measurements are not required.
  - 5.2 **Properties as Solution Heat Treated:**

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5.2.1 Tensile Properties:

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Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset or at Extension Indicated (E = 9,900,000)		Elongation % in 2 in. or 4D, min
		psi, min	Extension Under Load in. in 2 in.	
0.010 to 0.020, incl	27,000	14,000	0.0068	14
Over 0.020 to 0.249, incl	27,000	14,000	0.0068	16
Over 0.249 to 0.499, incl	27,000	14,000	0.0068	18
Over 0.499 to 1.000, incl	30,000	16,000	0.0072	18
Over 1.000 to 3.000, incl	30,000	16,000	0.0072	16

5.2.1.1 Tensile properties of plate over 3.000 in. in thickness shall be as agreed upon by purchaser and vendor.

5.2.1.2 When a dispute occurs between purchaser and vendor over the yield strength values, yield strength determined by the offset method shall apply.

5.2.2 Bending: Material shall be capable of withstanding, without cracking, bending at room temperature through an angle of 180 deg around a diameter equal to the bend factor times the nominal thickness of the material, with axis of bend parallel to direction of rolling.

Nominal Thickness Inch	Bend Factor
0.010 to 0.249, incl	3
Over 0.249 to 0.499, incl	5

5.3 Properties After Precipitation Heat Treatment: Material after proper precipitation heat treatment shall be capable of meeting the following requirements:

5.3.1 Tensile Properties:

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Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset or at Extension Indicated (E = 9,900,000)		Elongation % in 2 in. or 4D, min
		psi, min	Extension Under Load in. in 2 in.	
0.010 to 0.020, incl	38,000	32,000	0.0105	8
Over 0.020 to 0.499, incl	38,000	32,000	0.0105	10
Over 0.499 to 1.000, incl	42,000	35,000	0.0111	9
Over 1.000 to 2.000, incl	42,000	35,000	0.0111	8
Over 2.000 to 3.000, incl	42,000	35,000	0.0111	6

5.3.1.1 Tensile properties of plate over 3.000 in. in thickness shall be as agreed upon by purchaser and vendor.

5.3.1.2 When a dispute occurs between purchaser and vendor over the yield strength values, yield strength determined by the offset method shall apply.

5.3.2 Bending: Material shall be capable of withstanding, without cracking, bending at room temperature through an angle of 180 deg around a diameter equal to the bend factor times the nominal thickness of the material, with axis of bend parallel to direction of rolling.

Nominal Thickness Inch	Bend Factor
0.010 to 0.036, incl	3
Over 0.036 to 0.064, incl	4
Over 0.064 to 0.128, incl	5
Over 0.128 to 0.249, incl	6
Over 0.249 to 0.499, incl	10

6. QUALITY: Material 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.
7. TOLERANCES: Unless otherwise specified, tolerances shall conform to all applicable requirements of the latest issue of AMS 2202.
8. REPORTS:
  - 8.1 Unless otherwise specified, 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 technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, thickness, size, and quantity.
  - 8.2 Unless otherwise specified, 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 and its revision letter, 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.
9. IDENTIFICATION: Unless otherwise specified, each sheet and plate shall be marked on one face, in the respective location indicated below, with the alloy number and temper, AMS 4022 or applicable Federal or Military specification designation, manufacturer's identification and nominal thickness in inches. 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.
  - 9.1 Flat Sheet and Plate Under 6 In. Wide: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 feet.
  - 9.2 Flat Sheet and Plate 0.375 In. and Under Thick, 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 in inches. The other rows shall show the alloy number and temper and AMS 4022 or applicable Federal or Military specification designation.
  - 9.3 Flat Sheet and Plate Over 0.375 In. Thick, or Over 60 In. Wide, or Over 200 In. Long: Shall be marked as in 9.2 above 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 Paragraph 9 above. If two rows are used, one row shall show the alloy number and temper and AMS 4022 or applicable Federal or Military specification designation; the second row shall show the manufacturer's identification and nominal thickness in inches.
    - 9.3.1 If peripheral marking is applied to the full piece as produced, but partial sheets or plates are supplied, an arrow shall also be applied near one corner indicating the direction of rolling.
  - 9.4 Coiled Sheet: Shall be marked near the outside end of the coil. The inside end of the coil shall also be marked or shall have attached a tag or label marked with the information of Paragraph 9 above.