

Aluminum Alloy, Sheet and Plate, Alclad
4.4Cu - 1.5Mg - 0.60Mn (Alclad 2024-O, Sheet and Plate)
Annealed; or when specified, "As Fabricated" (2024-F)
(Composition similar to UNS A82024)

RATIONALE

AMS4461 is a new specification for normal alclad material in the -O and -F condition. Its publication will facilitate the cancellation of AMS QQ-A-250/5.

1. SCOPE

1.1 Form

This specification covers an aluminum alloy in the form of sheet and plate supplied in the annealed (O) condition. When specified, product shall be supplied in the "as fabricated" (F) temper.

1.2 Application

These products have been used typically for formed structural parts which will be subsequently heat treated, but usage is not limited to such applications.

1.2.1 Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking after heat treatment; ARP823 recommends practices to minimize such conditions.

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 International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2355 Quality Assurance, Sampling and Testing, Aluminum Alloys and Magnesium Alloy, Wrought Products (Except Forging Stock), and Rolled, Forged, or Flash Welded Rings

AMS2772 Heat Treatment of Aluminum Alloy Raw Materials

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<http://www.sae.org/technical/standards/AMS4461>**

ARP823 Minimizing Stress-Corrosion Cracking in Wrought Heat-Treatable Aluminum Alloy Products

AS1990 Aluminum Alloy Tempers

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B 594 Ultrasonic Inspection of Aluminum-Alloy Products for Aerospace Applications

ASTM B 660 Packaging/Packing of Aluminum and Magnesium Products

ASTM B 666/B 666M Identification of Aluminum and Magnesium Alloy Products

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, 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 percentages by weight as shown in Tables 1 and 2, determined in accordance with AMS2355.

TABLE 1 - COMPOSITION, CORE (2024)

Element	min	max
Silicon	--	0.50
Iron	--	0.50
Copper	3.8	4.9
Manganese	0.30	0.9
Magnesium	1.2	1.8
Chromium	--	0.10
Zinc	--	0.25
Titanium	--	0.15
Other Elements, each	--	0.05
Other Elements, total	--	0.15
Aluminum	remainder	

TABLE 2 - COMPOSITION, CLADDING (1230)

Element	min	max
Iron + Silicon	--	0.70
Copper	--	0.10
Manganese	--	0.05
Magnesium	--	0.05
Zinc	--	0.10
Titanium	--	0.03
Other Elements, each	--	0.03
Aluminum	99.30	--

3.2 Condition

3.2.1 Annealed in accordance with AMS2772.

3.2.2 When specified, material may be provided in the “as fabricated” (F) temper. Requirements of 3.3.1 do not apply to the F temper.

3.3 Properties

The product shall conform to the following requirements, determined in accordance with AMS2355 on the mill produced size.

3.3.1 As Annealed

3.3.1.1 Tensile Properties

Shall be as shown in Table 3 (See 8.5).

TABLE 3A - TENSILE PROPERTIES IN ANNEALED CONDITION, INCH/POUND UNITS

Nominal Thickness, Inches	Tensile Strength, ksi, max	Yield Strength at 0.2% Offset, ksi, max	Elongation in 2 inches or 4D, %, min
0.008 to 0.009, incl	30.0	14.0	10
Over 0.009 to 0.062, incl	30.0	14.0	12
Over 0.062 to 0.499, incl	32.0	14.0	12
Over 0.499 to 1.750, incl	32.0	--	12

TABLE 3B - TENSILE PROPERTIES IN ANNEALED CONDITION, SI UNITS

Nominal Thickness, Millimeters	Tensile Strength, MPa, max	Yield Strength at 0.2% Offset, MPa, max	Elongation in 50.8 mm or 4D, %, min
0.203 to 0.228, incl	207	97	10
Over 0.228 to 1.574, incl	207	97	12
Over 1.574 to 12.674, incl	221	97	12
Over 12.674 to 44.450, incl	221	--	12

3.3.1.2 Bending

Product shall withstand, without cracking, bending at room temperature through an angle of 180 degrees around a diameter equal to the bend factor shown in Table 4 times the nominal thickness of the product with axis of bend parallel to the direction of rolling.

TABLE 4 - BENDING PARAMETERS IN ANNEALED CONDITION

Nominal Thickness, Inches	Nominal Thickness, Millimeters	Bend Factor
0.008 to 0.032, incl	0.203 to 0.813, incl	0
Over 0.032 to 0.062, incl	Over 0.813 to 1.575, incl	1
Over 0.062 to 0.499, incl	Over 1.575 to 12.675, incl	2

3.3.2 Response to Heat Treatment (-T42, -T62, -T72 Temper)

The product, as received by purchaser, shall have the following properties shown in Table 5 after solution and precipitation heat treatment to the -T42 temper (See AS1990) in accordance with AMS2772. Material in the -T42 condition shall have the following properties shown in Table 5 after proper aging to the -T62 and -T72 temper (See AS1990) in accordance with AMS2772.

3.3.2.1 Tensile Properties

Shall be as shown in Table 5 (See 8.5).

TABLE 5A - TENSILE PROPERTIES IN T42, T62, AND T72 TEMPER, INCH/POUND UNITS

Temper	Nominal Thickness, Inches	Tensile Strength, ksi	Yield Strength at 0.2% Offset, ksi	Elongation in 2 inches or 4D, %
-T42	0.008 to 0.009, incl	55.0	34.0	10
	Over 0.009 to 0.020, incl	57.0	34.0	12
	Over 0.020 to 0.062, incl	57.0	34.0	15
	Over 0.062 to 0.249, incl	60.0	36.0	15
	Over 0.249 to 0.499, incl	60.0	36.0	12
	Over 0.499 to 1.000, incl	61.0	38.0	8
	Over 1.000 to 1.500, incl	60.0	38.0	7
	Over 1.500 to 2.000, incl	60.0	38.0	6
-T62	Over 2.000 to 3.000, incl	58.0	38.0	4
	0.010 to 0.062, incl	60.0	47.0	5
-T72	Over 0.062 to 0.499, incl	62.0	49.0	5
	0.010 to 0.062, incl	56.0	43.0	5
	Over 0.062 to 0.249, incl	58.0	45.0	5

TABLE 5B - TENSILE PROPERTIES IN T42, T62, AND T72 TEMPER, SI UNITS

Temper	Nominal Thickness, Millimeters	Tensile Strength, MPa	Yield Strength at 0.2% Offset, MPa	Elongation in 50.8 mm or 4D, %
-T42	0.203 to 0.229, incl	379	234	10
	Over 0.229 to 0.508, incl	393	234	12
	Over 0.508 to 1.575, incl	393	234	15
	Over 1.575 to 6.33, incl	414	248	15
	Over 6.33 to 12.68, incl	414	248	12
	Over 12.68 to 25.40, incl	421	262	8
	Over 25.40 to 38.10, incl	414	262	7
	Over 38.10 to 50.80, incl	414	262	6
	Over 50.80 to 76.20, incl	400	262	4
-T62	0.25 to 1.57, incl	414	324	5
	Over 1.57 to 12.67, incl	427	338	5
-T72	0.25 to 0.51, incl	386	296	5
	Over 0.51 to 6.32, incl	400	310	5

3.4 Thickness of Cladding Plates

The aluminum alloy plates that are bonded to the two sides of the aluminum alloy (2024) ingot or slab, to form a composite that is to be rolled, shall each have a thickness as specified in Table 6.

TABLE 6 - CLADDING THICKNESS

Nominal Thickness, Inches	Nominal Thickness, mm	Nominal Cladding Thickness Per Side, % of Thickness	Average Cladding Thickness Per Side, % of Thickness, Minimum
0.008 to 0.062, incl	0.203 to 1.57, incl	5	4
Over 0.062	Over 1.57	2.5	2

3.5 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.

3.5.1 When specified, each plate 0.500 to 1.750 inches (12.70 to 44.45 mm) shall be ultrasonically inspected in accordance with ASTM B 594 and shall meet the requirements of 3.4.1.1 or 3.4.1.2.

3.5.1.1 Plates shall meet the requirement for ultrasonic class B for plate 0.500 to 1.499 inches (12.70 to 38.07 mm) in nominal thickness.

3.5.1.2 Plates shall meet the requirement for ultrasonic class A for plates 1.500 to 1.750 inches (38.10 to 44.45 mm) in nominal thickness.

3.6 Tolerances

Shall conform to all applicable requirements of ANSI H 35.2 or ANSI H 35.2M.

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

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), tensile properties, as annealed (3.3.1) (not applicable to F temper), tensile properties for response to heat treatment to the -T42 temper, (3.3.2), tolerances (3.8) and, when specified, ultrasonic soundness (3.5) are acceptance tests and except for composition, shall be performed on each lot.

4.2.2 Periodic Tests

Bending as annealed (3.3.1.2) (not applicable to F temper), tensile properties for response to heat treatment to the, -T62 and -T72 tempers (3.3.2) and cladding thickness (3.4.1) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.