

AEROSPACE MATERIAL SPECIFICATION



AMS-QQ-A-250/5A

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Superseding AMS-QQ-A-250/5

Aluminum Alloy Alclad 2024, Plate and Sheet

A82024

RATIONALE

This document has been reaffirmed to comply with the SAE 5-year Review policy.

NOTICE

This document has been taken directly from Federal Specification QQ-A-250/5F, Amendment 2, and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards.

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The complete requirements for procuring 2024 aluminum alloy alclad plate and sheet described herein shall consist of this document and the latest issue of AMS-QQ-A-250.

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1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This specification covers the specific requirements for 2024 aluminum alloy alclad plate and sheet; the general requirements are covered in AMS-QQ-A-250. The plate and sheet covered by this specification shall be an integral composite product consisting of a heat-treatable aluminum alloy 2024 core with thin layers of an aluminum alloy 1230 (99.30 percent minimum aluminum) anodic to the core and of approximately equal thickness, bonded to both surfaces.

1.2 Classification:

- 1.2.1 Tempers: The plate and sheet are classified in one of the following tempers as specified (See 6.2 and 6.4): O, T3, T4, T42, T62, T72, T81, T351, T361, T851, T861, or F temper. Definitions of these tempers are specified in AMS-QQ-A-250.

2. APPLICABLE DOCUMENTS:

See AMS-QQ-A-250.

3. REQUIREMENTS:

3.1 Chemical Composition:

- 3.1.1 The chemical composition of the core ingots or slabs and of the cladding plates used for the manufacture of the alclad plate and sheet shall conform to the requirements specified in Table I for core and cladding, respectively.

TABLE I. Chemical Composition ^{1/}

Element	Core 2024		Cladding 1230
	Minimum	Maximum	Maximum
	<u>Percent</u>	<u>Percent</u>	<u>Percent</u>
Copper	3.8	4.9	0.10
Magnesium	1.2	1.8	0.05
Manganese	0.30	0.9	0.05
Iron	-	0.50	<u>2/</u>
Silicon	-	0.50	<u>2/</u>
Chromium	-	0.10	-
Nickel	-	-	-
Zinc	-	0.25	0.10
Titanium	-	0.15	0.03
Other Elements, each	-	0.05	0.03 <u>3/</u>
Other Elements, total <u>4/</u>	-	0.15	-
Aluminum	-	Remainder	99.30 Minimum

^{1/} Analysis shall routinely be made only for the elements specifically mentioned in Table I. If, however, the presence of other elements is indicated or suspected in amounts greater than the specified limits, further analysis shall be made to determine that these elements are not present in excess of specified limits.

^{2/} Iron plus silicon, 0.7 percent, maximum.

^{3/} Vanadium 0.05 percent maximum.

^{4/} The sum of those "Other" metallic elements 0.010 percent or more each, expressed to the second decimal before determining the sum.

3.2 Mechanical Properties:

3.2.1 Mechanical Properties of Material as Supplied: The mechanical properties perpendicular to the direction of final rolling, except for material under 9 inches in width, shall conform to the requirements of Table II for the temper specified. For material under 9 inches in width, the mechanical properties parallel to the direction of final rolling shall conform to the requirements of Table II for the temper specified.

TABLE II. Mechanical Properties (See 6.6)

Temper	Widths	Thickness	Tensile Strength minimum	Yield Strength at 0.2 percent Offset or at Extension Indicated		Elongation in 2 in. or 4 times D $\frac{1}{2}$, minimum
				Minimum	Extension under load	
	Inches	Inches	ksi	ksi	Inch/Inch	Percent
O	All	0.008 thru 0.009	30.0 $\frac{3}{4}$	14.0 $\frac{3}{4}$	0.0035	10
	All	0.010 thru 0.062	30.0 $\frac{3}{4}$	14.0 $\frac{3}{4}$	0.0035	12
	All	0.063 thru 0.499	32.0 $\frac{3}{4}$	14.0 $\frac{3}{4}$	0.0036	12
	All	0.500 thru 1.750 $\frac{4}{4}$	32.0 $\frac{3}{4}$	--	--	12
T3 $\frac{5}{4}$ (See 6.4)	All	0.008 thru 0.009	58.0	39.0	0.0061	10
	All	0.010 thru 0.020	59.0	39.0	0.0061	12
	All	0.021 thru 0.062	59.0	39.0	0.0061	15
	All	0.063 thru 0.128	61.0	40.0	0.0060	15
	All	0.129 thru 0.249	62.0	40.0	0.0060	15
T4 $\frac{6}{4}$	All	0.010 thru 0.020	58.0	36.0	0.0059	12
	All	0.021 thru 0.062	58.0	36.0	0.0059	15
	All	0.063 thru 0.128	61.0	38.0	0.0058	15
T361 $\frac{7}{4}$	All	0.020 thru 0.062	61.0	47.0	0.0070	8
	All	0.063 thru 0.499	64.0	48.0	0.0071	9
	All	0.500 $\frac{4}{4}$	66.0	49.0	0.0071	10
T42 $\frac{8}{4}$	All	0.008 thru 0.009	55.0	34.0	0.0056	10
	All	0.010 thru 0.020	57.0	34.0	0.0056	12
	All	0.021 thru 0.062	57.0	34.0	0.0056	15
	All	0.063 thru 0.249	60.0	36.0	0.0056	15
	All	0.250 thru 0.499	60.0	36.0	0.0058	12
	All	0.500 thru 1.000 $\frac{4}{4}$	61.0	38.0	0.0055	8
	All	1.001 thru 1.500 $\frac{4}{4}$	60.0	38.0	0.0056	7
	All	1.501 thru 2.000 $\frac{4}{4}$	60.0	38.0	0.0055	6
	All	2.001 thru 3.000 $\frac{4}{4}$	58.0	38.0	0.0055	4
T351	All	0.250 thru 0.499	62.0	40.0	0.0060	12
	All	0.500 thru 1.000 $\frac{4}{4}$	63.0	42.0	0.0060	8
	All	1.001 thru 1.500 $\frac{4}{4}$	62.0	42.0	0.0060	7
	All	1.501 thru 2.000 $\frac{4}{4}$	62.0	42.0	0.0060	6
	All	2.001 thru 3.000 $\frac{4}{4}$	60.0	42.0	0.0060	4
	All	3.001 thru 4.000 $\frac{4}{4}$	57.0	41.0	0.0058	4

TABLE II. Mechanical Properties (See 6.6) (Continued)

Temper	Widths	Thickness	Tensile Strength minimum	Yield Strength at 0.2 percent Offset or at Extension Indicated		Elongation in 2 in. or 4 times D <u>1</u> / <u>2</u> , minimum
				Minimum	Extension under load	
	Inches	Inches	ksi	ksi	Inch/Inch	Percent
T62 <u>8</u> /	All	0.010 thru 0.062	60.0	47.0	0.0070	5
	All	0.063 thru 0.499	62.0	49.0	0.0071	5
T72 <u>8</u> /	All	0.010 thru 0.062	56.0	43.0	0.0066	5
	All	0.063 thru 0.249	58.0	45.0	0.0068	5
T81 <u>5</u> /	All	0.010 thru 0.062	62.0	54.0	0.0077	5
	All	0.063 thru 0.249	65.0	56.0	0.0079	5
T861 <u>7</u> /	All	0.020 thru 0.062	64.0	58.0	0.0081	3
	All	0.063 thru 0.249	69.0	64.0	0.0084	4
	All	0.250 thru 0.499	68.0	62.0	0.0082	4
	All	0.500 <u>4</u> /	70.0	64.0	0.0081	4
T851	All	0.250 thru 0.499	65.0	56.0	0.0075	5
	All	0.500 thru 1.000 <u>4</u> /	66.0	58.0	0.0075	5
F	All	All	<u>9</u> /	<u>9</u> /	<u>9</u> /	<u>9</u> /

1/ Not required for material 1/2 inch or less in width.

2/ D represents specimen diameter.

3/ Maximum.

4/ These properties are those of the core alloy since the tests are made on a round specimen machined from the plate.

5/ Applicable to flat sheet only.

6/ Applicable to coiled sheet only.

7/ Applicable to flat sheet and plate only.

8/ Material in the T42, T62, or T72 temper is not available from material producers.

9/ No requirements.

3.2.2 Mechanical Properties After Heat Treatment: In addition to conforming to the requirements of 3.2.1, material in the annealed (O) and the as-fabricated (F) tempers shall, after proper solution heat-treatment, also conform to the requirements of Table II for the T42 temper. Material as received in the T3, T4, T351, T81, and T851 tempers shall, after proper re-solution heat-treatment, be capable of conforming to the requirements specified in Table II for the T42 temper. Material in the T42 temper shall, after proper aging, be capable of conforming to the requirements specified in Table II for the T62 or T72 temper. Material in the T3, T351, and T361 tempers shall, after proper aging, be capable of conforming to the requirements specified in Table II for the T81, T851, and T861 tempers, respectively.

- 3.2.3 Bend Test: Bend specimens taken from material shall be capable of withstanding, without cracking, the bend test specified in AMS-QQ-A-250. The values for bend factor N are given in Table III.

TABLE III. Bend Test Factor "N"

Thickness of Material	Temper			
	O	T3	T4 and T42	T361
Inch				
0.008 thru 0.009	0	4	4	-
0.010 thru 0.032	0	4	4	4
0.033 thru 0.040	1	4	4	4
0.041 thru 0.062	1	5	5	4
0.063 thru 0.128	2	5	5	6
0.129 thru 0.187	2	8	8	6
0.188 thru 0.249	2	8	8	8
0.250 thru 0.499	2	-	10	-

3.3 Cladding Thickness:

- 3.3.1 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 IV.

TABLE IV. Cladding Thickness

Thickness of finished plate or sheet	Nominal cladding thickness per side, percent of composite thickness	Average thickness per side of cladding on finished plate or sheet, minimum Percent of plate or sheet thickness
Inches		
Under 0.063	5	4
0.063 and over	2-1/2	2

- 3.3.2 Thickness of Cladding: If question arises concerning the thickness of cladding of the finished sheet or plate, samples examined in accordance with AMS-QQ-A-250 shall show an average thickness of cladding on each side, not less than that specified in Table IV.