



AEROSPACE MATERIAL SPECIFICATION

AMS-QQ-A-250/4

REV. B

Issued 1997-08
Revised 1998-09
Reaffirmed 2010-05
Stabilized 2015-02

Superseding AMS-QQ-A-250/4A

Aluminum Alloy 2024, Plate and Sheet

A92024

RATIONALE

AMS-QQ-A-250/4B stabilizes this specification because it is no longer state of the art and equivalent technical requirements are contained in other SAE Aerospace Material Specifications.

STABILIZATION NOTICE

AMS QQ-A-250/4A has been declared "STABILIZED" by AMS Committee D. This document will no longer be updated and may no longer represent standard industry practice. This document was stabilized because it contains requirements that are no longer state of the art and are also contained in alternate documents that contain equivalent requirements. Previously this document was reaffirmed as current. The last technical update of this document occurred in September 1998. Users of this document should refer any certification issues (e.g. exceptions listed on the certification report) to the cognizant engineering organization for their disposition. CAUTION: In many cases the purchaser is not the cognizant engineering organization (i.e. purchaser may be a sub tier supplier).

AMS Committee D recommends that the following technically equivalent specifications be used for future procurement. This listing does not constitute authority to substitute these specifications for the "STABILIZED" specification.

- AMS4035 Aluminum Alloy, Sheet and Plate 4.4Cu – 1.5Mg – 0.60Mn (2024-0) Annealed or when specified, "As Fabricated" (2024-F)
- AMS4037 Aluminum Alloy, Sheet and Plate 4.4Cu – 1.5Mg – 0.60Mn (2024-T3 Flat Sheet, -T351 Plate) Solution Heat Treated
- AMS4477 Aluminum Alloy, Coiled Sheet 4.4Cu – 1.5Mg – 0.60Mn (2024-T4) Solution Heat Treated
- AMS4268 Aluminum Alloy, Sheet and Plate 4.4Cu – 1.5Mg – 0.60Mn (2024-T81 Sheet, -T851 Plate) Solution Heat Treated, Cold Worked and Artificially Aged
- AMS4269 Aluminum Alloy, Sheet and Plate 4.4Cu – 1.5Mg – 0.60Mn (2024-T361) Solution Heat Treated and Cold Worked
- AMS4193 Aluminum Alloy, Sheet and Plate 4.4Cu – 1.5Mg – 0.60Mn (2024-T861) Solution Heat Treated, Cold Worked, and Precipitation Heat Treated

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SAE WEB ADDRESS:

1. SCOPE AND CLASSIFICATION:

1.1 Scope:

This specification covers the specific requirements for 2024 aluminum alloy plate and sheet; the general requirements are covered in AMS-QQ-A-250.

1.2 Classification:

1.2.1 Tempers: The plate and sheet are classified in one of the following tempers as specified (See 6.3): 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 shall conform to the requirements specified in Table I.

TABLE I. Chemical Composition ^{1/}

Element	Percent	
	Minimum	Maximum
Silicon	-	0.50
Iron	-	0.50
Copper	3.8	4.9
Manganese	0.30	0.9
Magnesium	1.2	1.8
Chromium	-	0.10
Nickel	-	-
Zinc	-	0.25
Titanium	-	0.15
Other Elements, each	-	0.05
Other Elements, total ^{2/}	-	0.15
Aluminum	Remainder	

^{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/} The sum of those "Others" 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	Width	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 ksi	Extension under load Inch/Inch	
	Inches	Inches	ksi	ksi	Inch/Inch	Percent
O	All	0.010 thru 0.499	$\frac{3}{32}$ 32.0	$\frac{3}{32}$ 14.0	0.0033	12
	All	0.500 thru 1.750	$\frac{3}{32}$ 32.0	-	-	12
T3 $\frac{4}{}$ (See 6.4)	All	0.008 thru 0.009	63.0	42.0	0.0060	10
	All	0.010 thru 0.020	63.0	42.0	0.0060	12
	All	0.021 thru 0.128	63.0	42.0	0.0060	15
	All	0.129 thru 0.249	64.0	42.0	0.0060	15
T4 $\frac{5}{}$	All	0.010 thru 0.020	62.0	40.0	0.0058	12
	All	0.021 thru 0.249	62.0	40.0	0.0058	15
T361 $\frac{6}{}$	All	0.020 thru 0.062	67.0	50.0	0.0068	8
	All	0.063 thru 0.249	68.0	51.0	0.0069	9
	All	0.250 thru 0.499	66.0	49.0	0.0067	9
	All	0.500	66.0	49.0	0.0067	10
T42 $\frac{7}{}$	All	0.010 thru 0.020	62.0	38.0	0.0056	12
	All	0.021 thru 0.249	62.0	38.0	0.0056	15
	All	0.250 thru 0.499	62.0	38.0	0.0056	12
	All	0.500 thru 1.000	61.0	38.0	0.0056	8
	All	1.001 thru 1.500	60.0	38.0	0.0056	7
	All	1.501 thru 2.000	60.0	38.0	0.0056	6
	All	2.001 thru 3.000	58.0	38.0	0.0056	4
T351	All	0.250 thru 0.499	64.0	42.0	0.0060	12
	All	0.500 thru 1.000	63.0	42.0	0.0060	8
	All	1.001 thru 1.500	62.0	42.0	0.0060	7
	All	1.501 thru 2.000	62.0	42.0	0.0060	6
	All	2.001 thru 3.000	60.0	42.0	0.0060	4
	All	3.001 thru 4.000	57.0	41.0	0.0059	4

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

Temper	Width Inches	Thickness Inches	Tensile Strength, minimum ksi	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 Percent
				Minimum ksi	Extension under load Inch/Inch	
T62 <u>7/</u>	All	0.010 thru 0.499	64.0	50.0	0.0068	5
	All	0.500 thru 3.000	63.0	50.0	0.0068	5
T72 <u>7/</u>	All	0.010 thru 0.249	60.0	46.0	0.0064	5
T81 <u>4/</u>	All	0.010 thru 0.249	67.0	58.0	0.0075	5
T861 <u>6/</u>	All	0.020 thru 0.062	70.0	62.0	0.0079	3
	All	0.063 thru 0.249	71.0	66.0	0.0083	4
	All	0.250 thru 0.500	70.0	64.0	0.0081	4
T851 (See 6.4)	All	0.250 thru 0.499	67.0	58.0	0.0075	5
	All	0.500 thru 1.000	66.0	58.0	0.0075	5
	All	1.001 thru 1.499	66.0	57.0	0.0075	5
F	All	All	<u>8/</u>	<u>8/</u>	<u>8/</u>	<u>8/</u>

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

2/ D represents specimen diameter.

3/ Maximum.

4/ Applicable to flat sheet only.

5/ Applicable to coiled sheet only.

6/ Applicable to flat sheet and plate only.

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

8/ No requirements.

3.2.2 Mechanical Properties After Heat Treatment: In addition to conforming to the requirement 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	Tempers			
	O	T3	T361	T4 and T42
Inch				
0.008 thru 0.009	-	4	-	-
0.010 thru 0.020	0	4	-	4
0.021 thru 0.032	0	5	4	5
0.033 thru 0.051	1	5	4	5
0.052 thru 0.063	1	6	8	6
0.064 thru 0.128	4	6	8	6
0.129 thru 0.249	6	8	8	8
0.250 thru 0.499	6	-	-	10

3.3 Internal Defects:

When specified (See 6.3), plate shall be ultrasonically inspected (See AMS-QQ-A-250). Acceptance limits shall be as specified in Table IV.

TABLE IV. Ultrasonic Discontinuity Acceptance Limits 1/

Thickness Inches	Maximum weight per piece Pounds	Discontinuity Class <u>2/</u>
0.500 thru 1.499	2,000	B
1.500 thru 3.000	2,000	A
3.001 thru 4.000	2,000	B

1/ Discontinuities in excess of those listed in Table IV may be allowed, subject to approval of the procuring activity, if it is established that they will be removed by machining or that they are in non-critical areas.

2/ The discontinuity class limits are defined in MIL-I-8950.