

QQ-A-250/4E
January 18, 1971
SUPERSEDING
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March 17, 1967

FEDERAL SPECIFICATION

ALUMINUM ALLOY 2024, PLATE AND SHEET

This specification was approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

(This specification forms a part of the latest issue of Federal Specification QQ-A-250.)

1. SCOPE AND CLASSIFICATION

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

1.2 Classification.

1.2.1 Temper. The plate and sheet shall be classified as O, T3, T4, T36, T42, T62, T72, T81, T86, T351, T361, T851, T861, or F temper, as specified (see 6.2). The definitions of these tempers shall be as specified in American National Standard AWS H35.1.

2. APPLICABLE DOCUMENTS

Latest issue of Federal Specification:

QQ-A-250 - Aluminum and Aluminum Alloy Plate and Sheet; General Specification for.

(Activities outside the Federal Government may obtain copies of Federal Specifications and Standards, as outlined under General Information in the Index of Federal Specifications and Standards and at the prices indicated in the Index. The Index, which includes cumulative monthly supplements as issued, is for sale on a subscription basis by the Superintendent of Documents, U. S. Government Printing Office, Washington, D. C. 20402.

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(Federal Government activities may obtain copies of Federal Specifications, Standards, and Handbooks and the Index of Federal Specifications and Standards from the established distribution points in their agencies.)

(Copies of Military Specifications and Standards required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

American National Standards Institute:

ANS H35.1 - Alloy and Temper Designation Systems for Aluminum.

(Application for copies should be addressed to the American National Standards Institute, 1430 Broadway, New York, New York 10018.)

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/}

	Percent	
	Minimum	Maximum
Copper	3.8	4.9
Magnesium	1.2	1.8
Manganese	0.30	0.9
Silicon	-	.50
Iron	-	.50
Zinc	-	.25
Chromium	-	.10
Others, each	-	.05
Others, total	-	.15
Aluminum	Remainder	

^{1/} Analysis shall regularly be made only for the elements specifically mentioned in this table I. If, however, the presence of other elements is indicated in the course of routine analysis, further analysis shall be made to determine conformance to the limits specified for other elements.

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 less than 9 inches in width, shall conform to the requirements of table II for the temper specified. For material less than 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.

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TABLE II. Mechanical properties

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 ₁ /2, minimum
				Minimum	Extension under load	
	Inches	Inches	P.s.i.	P.s.i.	Inch/Inch	Percent
O	All	0.010 thru 0.499	3/32,000	3/14,000	0.0033	12
	All	.500 thru 1.750	3/32,000	-	-	12
T3 4/	All	0.008 thru 0.009	63,000	42,000	0.0060	10
	All	.010 thru .020	64,000	42,000	.0060	12
	All	.021 thru .249	64,000	42,000	.0060	15
T4 5/	All	0.010 thru 0.020	62,000	40,000	0.0058	12
	All	.021 thru .249	62,000	40,000	.0058	15
T36 6/	30 and under	0.020 thru 0.062	69,000	52,000	0.0070	8
	30 and under	.063 thru .499	69,000	52,000	.0070	9
	30 and under	.500	69,000	52,000	.0070	10
	over 30 thru 48	.020 thru .062	69,000	52,000	.0070	8
	over 30 thru 48	.063 thru .249	69,000	52,000	.0070	9
	over 30 thru 48	.250 thru .500	69,000	52,000	.0070	10
	over 48 thru 60	.020 thru .062	67,000	50,000	.0068	8
	over 48 thru 60	.063 thru .249	68,000	51,000	.0069	9
	over 48 thru 60	.250 thru .500	67,000	50,000	.0068	10
	over 60	.063 thru .249	67,000	50,000	.0068	8
	over 60	.250 thru .499	66,000	49,000	.0067	9
	over 60	.500	66,000	49,000	.0067	10
T361 6/	All	0.020 thru 0.062	67,000	50,000	0.0068	8
	All	.063 thru .249	68,000	51,000	.0069	9
	All	.250 thru .499	66,000	49,000	.0067	9
	All	.500	66,000	49,000	.0067	10
T42 7/	All	0.010 thru 0.020	62,000	38,000	0.0056	12
	All	.021 thru .249	62,000	38,000	.0056	15
	All	.250 thru .499	62,000	38,000	.0056	12
	All	.500 thru 1.000	61,000	38,000	.0056	8
	All	1.001 thru 1.500	60,000	38,000	.0056	7
	All	1.501 thru 2.000	60,000	38,000	.0056	6
	All	2.001 thru 3.000	58,000	38,000	.0056	4
T351	All	0.250 thru 0.499	64,000	42,000	0.0060	12
	All	.500 thru 1.000	63,000	42,000	.0060	8
	All	1.001 thru 1.500	62,000	42,000	.0060	7
	All	1.501 thru 2.000	62,000	42,000	.0060	6
	All	2.001 thru 3.000	60,000	42,000	.0060	4
	All	3.001 thru 4.000	57,000	41,000	.0059	4
T62 7/	All	0.010 thru 0.499	64,000	50,000	0.0068	5
	All	.500 thru 3.000	63,000	50,000	.0068	5
T72 7/	All	0.010 thru 0.249	60,000	46,000	0.0064	5
T81 4/	All	0.010 thru 0.249	67,000	58,000	0.0075	5

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TABLE II. Mechanical properties - Continued

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 ₁ /2, minimum
				Minimum	Extension under load	
	Inches	Inches	P.s.i.	P.s.i.	Inch/inch	Percent
T86 6/	30 and under	0.020 thru 0.062	72,000	66,000	0.0083	3
	30 and under	.063 thru .249	72,000	68,000	.0085	4
	30 and under	.250 thru .500	72,000	67,000	.0084	4
	over 30 thru 48	.020 thru .062	72,000	66,000	.0083	3
	over 30 thru 48	.063 thru .249	72,000	67,000	.0084	4
	over 30 thru 48	.250 thru .500	71,000	66,000	.0083	4
	over 48 thru 60	.020 thru .062	70,000	62,000	.0079	3
	over 48 thru 60	.063 thru .249	71,000	67,000	.0084	4
	over 48 thru 60	.250 thru .500	70,000	65,000	.0082	4
	over 60	.063 thru .249	71,000	66,000	.0083	4
T861 6/	All	0.020 thru 0.062	70,000	62,000	0.0079	3
	All	.063 thru .249	71,000	66,000	.0083	4
	All	.250 thru .500	70,000	64,000	.0081	4
	All	0.250 thru 0.499	67,000	58,000	0.0075	5
T851	All	.500 thru 1.000	66,000	58,000	.0075	5
	All	All	8/	8/	8/	8/

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 the materials 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, T36, T351, and T361 tempers shall, after proper aging, be capable of conforming to the requirements specified in table II for the T81, T86, T851, and T861 tempers, respectively.

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

TABLE III. Bend test factor "N"

Thickness of material	Temper			
	0	T3	T36 and T361	T4 and T42
Inch				
0.008 thru 0.009	-	4	-	-
.010 thru .020	0	4	-	4
.021 thru .032	0	5	4	5
.033 thru .051	1	5	4	5
.052 thru .063	1	6	8	6
.064 thru .128	4	6	8	6
.129 thru .249	6	8	8	8
.250 thru .499	6	-	-	10

3.3 Internal defects. When specified (see 6.2), plate shall be ultrasonically inspected (see QQ-A-250). Acceptance limits shall be as specified in table IV.

TABLE IV. Ultrasonic discontinuity acceptance limits ^{1/}

Thickness	Maximum weight per piece	Discontinuity class ^{2/}
Inches	Pounds	
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 the 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.

3.4 Marking. In addition to the marking required in Fed. Std. No. 184, material in the T81, T86, T851, and T861 tempers shall be identified by a lot number marked in at least one location on each piece. Plate and sheet in the T36 and T86 tempers shall also be marked immediately after the temper designation with the original width of the material, as follows:

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Original width	Identification marking
Inches	
Up thru 30	≡ 30
Over 30 thru 48	≡ 48
Over 48 thru 60	≡ 60
Over 60	∨ 60

4. QUALITY ASSURANCE PROVISIONS (See QQ-A-250.)

4.1 Heat treatment.

4.1.1 Aging period before testing. Specimens in the T3, T4, T36, T42, T351 and T361 tempers will not be required to be tested within 4 days after completion of the heat treatment. If the manufacturer so elects, samples may be tested after less than 4 days aging; but if they fail to show the specified properties, the test samples shall be discarded and additional samples shall be tested after 4 days' aging.

4.2 Mechanical test after heat treatment.

4.2.1 Number of test after heat treatment. From material in the annealed (O) and as-fabricated (F) tempers, an additional number of specimens equal to those required by QQ-A-250 shall be taken and tested after solution heat-treatment to determine compliance with 3.2.2.

5. PREPARATION FOR DELIVERY (See QQ-A-250.)

6. NOTES

6.1 Intended use. This alloy is intended for use where high strength is required and no welding is involved. Tempers T351 and T4 should not be used where optimum corrosion resistance is required. Tempers T62, T72, and T851 should be specified when optimum resistance to stress corrosion is required. The T351 and T851 tempers are intended primarily to provide material with low residual stresses and consequent minimum distortion during machining.

6.2 Ordering data. Purchasers should select the preferred options permitted herein and include the following information in procurement documents:

- (a) Title, number, and date of this specification.
- (b) Form and temper required (see 1.2.1).

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- (c) Dimensions required.
- (d) Requirements for sizes not specifically covered (see QQ-A-250).
- (e) Whether ultrasonic inspection of plate is required (see 3.3).
- (f) Selection of applicable levels of preservation, packaging, and packing required, if other than level C (see QQ-A-250).

6.3 Temper. Tempers T351 and T851 are available in plate only.

MILITARY CUSTODIANS:

Army - MR
Navy - AS
Air Force - 11

Preparing activity:

Navy - AS
(Project 9535-0192-4)

Review activities:

Army - MR, MI, MU, WC
Navy - SH, AS, YD, EC
Air Force - 85

User activities:

Army - EL, ME
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