

QQ-A-250/5F
January 18, 1971
SUPERSUDDING
Fed. Spec. QQ-A-250/5E
March 17, 1967

FEDERAL SPECIFICATION

ALUMINUM ALLOY ALCLAD 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 Alclad 2024 plate and sheet: the general requirements are covered in 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 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 and 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, Standards, and Handbooks 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, DC 20402.

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(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 10016.)

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 1 for core and cladding, respectively.

TABLE 1. Chemical composition ^{1/}

Element	Core 2024		Cladding 1230
	Minimum	Maximum	Maximum
	Percent	Percent	Percent
Copper	3.8	4.9	0.10
Magnesium	1.2	1.8	-
Manganese	0.30	0.9	.05
Iron	-	.50	2/
Silicon	-	.50	2/
Chromium	-	.10	-
Zinc	-	.25	.10
Others, each	-	.05	.05
Others, total	-	.15	-
Aluminum	-	Remainder	3/ 99.30

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- 1/ Analysis shall regularly be made only for the elements specifically mentioned in the above table. 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.
- 2/ Iron plus silicon, 0.7 percent, maximum.
- 3/ Minimum, by difference.

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.

TABLE II. Mechanical properties

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 ₁ /, 2/. minimum
				Minimum	Extension under load	
	Inches	Inches	P.s.i.	P.s.i.	Inch/Inch	Percent
O	All	0.008 thru 0.009	30,000 3/	14,000 3/	0.0035	10
	All	.010 thru .062	30,000 3/	14,000 3/	.0035	12
	All	.063 thru .499	32,000 3/	14,000 3/	.0036	12
	All	.500 thru 1.750	32,000 3/	--	--	12
T3 5/	All	0.008 thru 0.009	58,000	39,000	0.0061	10
	All	.010 thru .020	59,000	39,000	.0061	12
	All	.021 thru .062	59,000	39,000	.0061	15
	All	.063 thru .249	62,000	40,000	.0060	15
T4 6/	All	0.010 thru 0.020	58,000	36,000	0.0059	12
	All	.021 thru 0.062	58,000	36,000	.0059	15
	All	.063 thru 0.126	61,000	38,000	.0058	15
T36 1/	Up thru 48	0.020 thru 0.062	62,000	48,000	0.0071	8
	Up thru 48	.063 thru .499	66,000	50,000	.0070	9
	Up thru 48	.500 4/	69,000	52,000	.0070	10
	Over 48 thru 60	.020 thru .062	61,000	47,000	.0070	8
	Over 48 thru 60	.063 thru .499	65,000	49,000	.0071	9
	Over 48 thru 60	.500 4/	67,000	50,000	.0070	10
	Over 60	.063 thru .499	64,000	48,000	.0071	9
	Over 60	.500 4/	66,000	49,000	.0071	10
T361 7/	All	0.020 thru 0.062	61,000	47,000	0.0070	8
	All	.063 thru .499	64,000	48,000	.0071	9
	All	.500 4/	66,000	49,000	.0071	10

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TABLE 11. Mechanical properties (Cont'd.)

Temper	Widths	Thickness	Tensile strength, minimum	Yield strength at 0.2 percent offset or at extension indicated		Elongation* in 2 in. or 4 times D1/2/ minimum
				Minimum	Extension under load	
	Inches	Inches	P.s.i.	P.s.i.	Inch/Inch	Percent
T42 8/	All	0.008 thru 0.009	55,000	34,000	0.0056	10
	All	.010 thru .020	57,000	34,000	.0056	12
	All	.021 thru .062	57,000	34,000	.0056	15
	All	.063 thru .249	60,000	36,000	.0056	15
	All	.250 thru .499	60,000	36,000	.0058	12
	All	.500 thru 1.000 4/	61,000	38,000	.0058	8
	All	1.001 thru 1.500 4/	60,000	38,000	.0056	7
	All	1.501 thru 2.000 4/	60,000	38,000	.0055	6
	All	2.001 thru 3.000 4/	58,000	38,000	.0055	4
T351	All	0.250 thru 0.499	62,000	40,000	0.0060	12
	All	.500 thru 1.000 4/	63,000	42,000	.0060	8
	All	1.001 thru 1.500 4/	62,000	42,000	.0060	7
	All	1.501 thru 2.000 4/	62,000	42,000	.0060	6
	All	2.001 thru 3.000 4/	60,000	42,000	.0060	4
	All	3.001 thru 4.000 4/	57,000	41,000	.0058	4
T62 8/	All	0.010 thru 0.062	60,000	47,000	0.0070	5
	All	.063 thru .499	62,000	49,000	.0071	5
T72 8/	All	0.010 thru 0.062	56,000	43,000	0.0066	5
	All	.063 thru .249	58,000	45,000	.0068	5
T81 2/	All	0.010 thru 0.062	62,000	54,000	0.0077	5
	All	.063 thru .249	65,000	56,000	.0079	5
T88 1/	Up thru 30	0.020 thru 0.062	66,000	62,000	0.0085	3
	Up thru 30	.063 thru .249	70,000	66,000	.0085	4
	Up thru 30	.250 thru .499	70,000	65,000	.0085	4
	Up thru 30	.500 4/	72,000	67,000	.0084	4
	Over 30 thru 48	.020 thru .062	66,000	62,000	.0085	3
	Over 30 thru 48	.063 thru .249	70,000	65,000	.0085	4
	Over 30 thru 48	.250 thru .499	69,000	64,000	.0084	4
	Over 30 thru 48	.500 4/	71,000	66,000	.0083	4
	Over 48 thru 60	.020 thru .062	64,000	58,000	.0081	3
	Over 48 thru 60	.063 thru .249	69,000	65,000	.0085	4
	Over 48 thru 60	.250 thru .499	68,000	63,000	.0083	4
	Over 48 thru 60	.500 4/	70,000	65,000	.0082	4
	Over 60	.063 thru .249	69,000	64,000	.0084	4
	Over 60	.250 thru .499	68,000	62,000	.0082	4
	Over 60	.500 4/	70,000	64,000	.0081	4

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TABLE II. Mechanical properties (Cont'd.)

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 ₁ /2/. minimum
				Minimum	Extension under load	
	Inches	Inches	P.s.i.	P.s.i.	Inch/inch	Percent
T861 ^{7/}	All	0.020 thru 0.062	64,000	58,000	0.0081	3
	All	.063 thru .249	69,000	64,000	.0084	4
	All	.250 thru .499	68,000	62,000	.0082	4
	All	.500 ^{4/}	70,000	64,000	.0081	4
T851	All	0.250 thru 0.499 ^{4/}	65,000	56,000	0.0075	5
	All	.500 thru 1.000 ^{4/}	66,000	58,000	.0075	5
F	All	All	9/	9/	9/	9/

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 the materials 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, 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.

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.

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TABLE III. Bend test factor "N"

Thickness of material	Temper			
	0	T3	T4 and T42	T36 and T36T
Inch				
0.008 thru 0.009	0	4	4	-
.010 thru .032	0	4	4	4
.033 thru .040	1	4	4	4
.041 thru .062	1	5	5	4
.063 thru .128	2	5	5	6
.129 thru .187	2	8	8	6
.188 thru .249	2	8	8	6
.250 thru .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 QQ-A-250 shall show an average thickness of cladding on each side, not less than that specified in table IV.

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

TABLE V. 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 V 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 noncritical areas.

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

3.5 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 on 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:

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.

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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. Alclad 2024 plates and sheets are used where high strength with good resistance to corrosion are required. Formability is better than for Alclad 7075-T6 but strength is not quite so high. Elevated temperature properties are somewhat superior to those of 7075.

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).
- (c) Dimensions required.
- (d) Requirements for sizes not specifically covered (see QQ-A-250).
- (e) Whether ultrasonic inspection of plate is required (see 3.4).
- (f) Selection of applicable levels of preservation, packaging, and packing required, if other than level 0 (See QQ-A-250).

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

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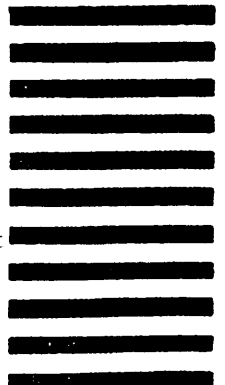
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