# AEROSPACE MATERIAL SPECIFICATION

| AMS-QQ-A-250™/5 | REV. C |
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Issued 1997-08
Revised 1998-09
Reaffirmed 2010-05
Stabilized 2021-05

Superseding AMS-QQ-A-250/5B


## Aluminum Alloy Alclad 2024, Plate and Sheet

A82024

RATIONALE

AMS-QQ-A-250/5C corrects an error in the similar specification referenced for 2024-T861 sheet and plate called out in the stabilization notice.

STABILIZED NOTICE

AMS-QQ-A-250/5C remains stabilized. AMS-QQ-A-250/5B was "STABILIZED" by AMS Committee D in 2014. This document will no longer be updated and may no longer represent standard industry practice. The last technical update of this document occurred in August 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 (e.g., properties, fit, form, function) specifications be used for future procurement. This listing does not constitute authority to substitute these specifications for the "STABILIZED" specification.

| | |
|---|---|
| AMS4461 | 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) |
| AMS4462 | Aluminum Alloy, Sheet and Plate, Alclad 4.4Cu - 1.5Mg - 0.60Mn (Alclad 2024, -T3 Sheet, -T351 Plate) Solution Heat Treated, Cold Worked and Naturally Aged |
| AMS4475 | Aluminum Alloy, Coiled Sheet, Alclad 4.4Cu - 1.5Mg - 0.60Mn (Alclad 2024; -T4 Coiled Sheet) Solution Heat Treated |
| AMS4478 | Aluminum Alloy, Sheet and Plate, Alclad 4.4Cu - 1.5Mg - 0.60Mn (Alclad 2024, -T81 Sheet, -T851 Plate) Solution Heat Treated, Cold Worked and Artificially Aged |
| AMS4466 | Aluminum Alloy, Sheet and Plate, Alclad 4.4Cu - 1.5Mg - 0.60Mn (2024, -T361 Sheet & Plate) Solution Heat Treated 6% Cold Worked and Naturally Aged |
| AMS4467 | Aluminum Alloy, Sheet and Plate, Alclad 4.4Cu - 1.5Mg - 0.60Mn (2024, -T861 Sheet & Plate) Solution Heat Treated 6% Cold Worked and Artificially Aged |






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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.

The original Federal Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, (b) the use of the existing government specification or standard format, and (c) the exclusion of any qualified product list (QPL) sections.

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.

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 | | Claddng 1230 |
|---|---|---|---|
| | Minimum | Maximum | Maximum |
| | Percent | Percent | Percent |
| Copper | 3.8 | 4.9 | 0.10 |
| Magnesium | 1.2 | 1.8 | 0.05 |
| Manganese | 0.30 | 0.9 | 0.05 |
| Iron | - | 0.50 | 2/ |
| Silicon | - | 0.50 | 2/ |
| Chromium | - | 0.10 | - |
| Nickel | - | - | - |
| Zinc | - | 0.25 | 0.10 |
| Titanium | - | 0.15 | 0.03 |
| Other Elements, each | - | 0.05 | 0.03 3/ |
| Other Elements, total 4/ | - | 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 1/, 2/, minimum |
|---|---|---|---|---|---|---|
| | | | | Minimum | Extension under load | |
| | Inches | Inches | ksi | ksi | Inch/Inch | Percent |
| O | All | 0.008 thru 0.009 | 30.0 3/ | 14.0 3/ | 0.0035 | 10 |
| | All | 0.010 thru 0.062 | 30.0 3/ | 14.0 3/ | 0.0035 | 12 |
| | All | 0.063 thru 0.499 | 32.0 3/ | 14.0 3/ | 0.0036 | 12 |
| | All | 0.500 thru 1.750 4/ | 32.0 3/ | -- | -- | 12 |
| T3 5/ (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 6/ | 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 7/ | 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 4/ | 66.0 | 49.0 | 0.0071 | 10 |
| T42 8/ | 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 4/ | 61.0 | 38.0 | 0.0055 | 8 |
| | All | 1.001 thru 1.500 4/ | 60.0 | 38.0 | 0.0056 | 7 |
| | All | 1.501 thru 2.000 4/ | 60.0 | 38.0 | 0.0055 | 6 |
| | All | 2.001 thru 3.000 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 4/ | 63.0 | 42.0 | 0.0060 | 8 |
| | All | 1.001 thru 1.500 4/ | 62.0 | 42.0 | 0.0060 | 7 |
| | All | 1.501 thru 2.000 4/ | 62.0 | 42.0 | 0.0060 | 6 |
| | All | 2.001 thru 3.000 4/ | 60.0 | 42.0 | 0.0060 | 4 |
| | All | 3.001 thru 4.000 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 1/, 2/, minimum |
|---|---|---|---|---|---|---|
| | | | | Minimum | Extension under load | |
| | Inches | Inches | ksi | ksi | Inch/Inch | Percent |
| T62 8/ | 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 8/ | 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 5/ | 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 7/ | 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 4/ | 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 4/ | 66.0 | 58.0 | 0.0075 | 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 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 | Tempers | | | |
|---|---|---|---|---|
| | 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 averge thickness of cladding on each side, not less than that specified in Table IV.