SAE Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

# AEROSPACE MATERIAL SPECIFICATION

SAE AMS-7852 REV A

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Superseding AMS-7852

Submitted for recognition as an American National Standard

## SHEET, STRIP, AND PLATE, COLUMBIUM ALLOY 10Hf - 1.0Ti

UNS R04295

1. SCOPE:

1.1 Form: This specification covers a columbium alloy in the form of sheet, strip, and plate.

1.2 Application: Primarily for parts requiring exposure at ultra-high temperatures. Applications in oxidizing atmospheres necessitate a protective coating.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

2.1.1 Aerospace Material Specifications:

AMS-2242 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
MAM-2242 - Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
AMS-2809 - Identification, Titanium and Titanium Alloy Wrought Products

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 3 - Preparation of Metallographic Specimens
ASTM E 8 - Tension Testing of Metallic Materials
ASTM E 8M - Tension Testing of Metallic Materials (Metric)
ASTM E 112 - Determining Average Grain Size
ASTM E 290 - Semi-Guided Bend Test for Ductility of Metallic Materials
ASTM E 384 - Microhardness of Materials

2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.10 Composition: Shall conform to the following percentages by weight; metallic elements shall be determined by spectrochemical methods or by other analytical methods acceptable to purchaser, carbon shall be determined by conductometric methods, gaseous elements shall be determined by vacuum fusion gas analysis, and columbium shall be determined by difference:

| | min | max | Check Analysis Under min or over max |
|---|---|---|---|
| Hafnium | 9.00 | 11.00 | 0.15 |
| Titanium | 0.70 | 1.30 | 0.07 |
| Zirconium | -- | 0.70 | 0.05 |
| Tungsten | -- | 0.50 | 0.03 |
| Tantalum | -- | 0.50 | 0.05 |
| Carbon | -- | 0.015 | None |
| Oxygen | -- | 0.0225 (225 PPM) | None |
| Nitrogen | -- | 0.015 (150 PPM) | None |
| Hydrogen | -- | 0.0015 ( 15 PPM) | None |
| Other Elements, total (3.1.1) | -- | 0.30 | None |
| Columbium | remainder | | |

3.1.1 Determination not required for routine acceptance.

3.2 Condition: Cold rolled or hot-cold rolled, descaled, and recrystallized.

3.2.1 Surfaces shall be visually free from oxide or other contamination and shall have a surface appearance comparable to a commercial corrosion-resistant steel No. 1 finish. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.2.2 Pits, scratches, or gouges are acceptable if they are not deeper than 0.005 inch (0.13 mm) or 3% of the product thickness, whichever is less. Surface imperfections may be removed and the affected area blended smoothly into adjacent surfaces provided the tolerances of 3.5 are maintained.

3.2.3 Burr height on any edge shall not exceed 5% of the nominal thickness.

3.3 Properties: The product shall conform to the following requirements

3.3.1 Grain Size: Shall be as follows, determined by comparison of a polished and etched specimen with the chart in ASTM E 112:

3.3.1.1 Sheet and Strip Under 0.160 Inch (4.06 mm) in Nominal Thickness: Predominantly 5 or finer with occasional grains as large as 3 permissible.

3.3.1.2 Product 0.160 to 0.750 Inch (4.06 to 19.05 mm) Incl. in Nominal Thickness: Predominantly 3 or finer with occasional grains as large as 1 permissible.

3.3.1.3 Plate Over 0.750 Inch (19.05 mm) in Nominal Thickness: As agreed upon by purchaser and vendor.

3.3.2 Tensile Properties: Shall be as follows, determined in accordance with ASTM E 8 or ASTM E 8M

3.3.2.1 Product 0.125 Inch (3.18 mm) and Under in Nominal Thickness:

| | |
|---|---|
| Tensile Strength, minimum | 54,000 psi (372 MPa) |
| Yield Strength at 0.2% Offset, minimum | 40,000 psi (276 MPa) |
| Elongation in 1 Inch (25.4 mm), minimum | 20% |

3.3.2.2 Product Over 0.125 Inch (3.18 mm) in Nominal Thickness:

| | |
|---|---|
| Tensile Strength, minimum | 54,000 psi (372 MPa) |
| Yield Strength at 0.2% Offset, minimum | 38,000 psi (276 MPa) |
| Elongation in 1 Inch (25.4 mm), minimum | 20% |

3.3.3 Bending: The product shall withstand, without fracture, bending in accordance with ASTM E 290 at 64° - 84°F (18° - 29°C) through an angle of 105 degrees around the diameters indicated in 3.3.3.1 or 3.3.3.2 with axis of bend parallel to the direction of rolling. Speed of the ram shall be not less than 1.0 inch (25 mm) per minute.

3.3.3.1 Sheet and Strip 0.060 Inch (1.52 mm) and Under in Nominal Thickness: Diameter equal to nominal thickness.

3.3.3.2 Product Over 0.060 Inch (1.52 mm) in Nominal Thickness: Diameter equal to twice the nominal thickness.

3.3.4 Microstructure: Shall be as follows, determined at 100X magnification on specimens prepared in accordance with ASTM E 3:

3.3.4.1 Segregation: Product shall be free from evidence of unalloyed elements and from segregation of alloying constituents.

3.3.4.2 Surface Contamination: Product shall be free from evidence of surface contamination. A difference in hardness of 50 points or more l00HK, determined in accordance with ASTM E 384, between the center of the specimen and a point 0.0015 inch (0.038 mm) from any as-supplied surface shall be evidence of surface contamination.

3.3.4.3 Recrystallization: Product shall show evidence of recrystallization as follows:

| Nominal Thickness | | Minimum Extent of Recrystallization |
|---|---|---|
| Inch | Millimetres | |
| Up to 0.150, incl | Up to 3.81, incl | 95% |
| Over 0.150 to 0.250, incl | Over 3.81 to 6.35, incl | 90% |
| Over 0.250 to 1.000, incl | Over 6.35 to 25.40, incl | 85% |

3.3.4.3.1 Recrystallization requirements for plate over 1.00 inch (25.40 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4 Quality:

3.4.1 Alloy shall be multiple vacuum melted using electron beam or consumable electrode practice.

3.4.2 The product, as received by purchaser, shall be uniform in quality, condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.5 Tolerances: Shall conform to all applicable requirements of AMS-2242 or MAM-2242.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspections: The vendor of the product shall supply all
0 samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests: Tests for all technical requirements are acceptance tests and shall be performed on each lot.

4.3 Sampling and Testing: Shall be in accordance with the following: a lot
0 shall be all product of the same nominal thickness from the same heat of alloy processed at the same time and presented for vendor's inspection at one time:

4.3.1 Tensile Properties: Not less than two specimens from each lot.

4.3.1.1 Specimens for tensile tests of widths 9 inches (229 mm) and over shall be taken with the axis of the specimen perpendicular to the direction of rolling; for widths under 9 inches (229 mm), specimens shall be taken with the axis parallel to the direction of rolling.

4.3.2 Bending: Not less than one specimen from each lot.

4.3.3 Microstructure: Not less than two specimens from each lot.