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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-7851 REV B

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Submitted for recognition as an American National Standard

Superseding AMS-7851A

FOIL, SHEET, STRIP, AND PLATE, COLUMBIUM ALLOY 10W - 2.5Zr Recrystallized

UNS R04271

1. SCOPE:

1.1 This specification covers a columbium alloy in the form of foil, sheet, strip, or 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.

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 8 - Tension Testing of Metallic Materials
ASTM E 8M - Tension Testing of Metallic Materials (Metric)
ASTM E 21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E 92 - Vickers Hardness of Metallic Materials
ASTM E 290 - Semi-Guided Bend Test for Ductility of Metallic 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:

3.1 Composition: Shall conform to the following percentages by weight; Ø metallic elements shall be determined by spectrochemical methods or by other analytical methods acceptable to purchaser carbon shall be determined by conductometric methods, oxygen shall be determined by the vacuum fusion or conductometric method, nitrogen shall be determined by the Kjeldahl method, and hydrogen shall be determined by the vacuum extraction method:

	min	max
Tungsten	9.0	11.0
Zirconium	2.0	3.0
Tantalum	—	0.15
Carbon	—	0.030
Silicon	—	0.02
Iron	—	0.02
Titanium	—	0.01
Oxygen	—	0.020 (200 ppm)
Nitrogen	—	0.010 (100 ppm)
Hydrogen	—	0.001 (10 ppm)
Columbium	remainder	

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

3.3 Heat Treatment: Product shall be recrystallized by heating to a temperature within the range 2200° – 2400°F (1204° – 1316°C) under vacuum of absolute pressure less than 0.1 micron (0.1 µm) mercury or inert atmosphere or as agreed upon by purchaser and vendor.

3.4 Properties: The product shall conform to the following requirements:

3.4.1 Tensile Properties: Product, 0.010 – 0.060 inch (0.25 – 1.52 mm), incl, in nominal thickness, shall meet the requirements of 3.4.1.1 and 3.4.1.2; tensile property requirements for product under 0.010 inch (0.25 mm) or over 0.060 inch (1.52 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.1.1 At Room Temperature: Shall be as follows for sheet and strip 0.010 - 0.060 inch (0.25 – 1.52 mm), incl, in nominal thickness, determined in accordance with ASTM E 8 or ASTM E 8M with the rate of strain maintained at 0.003 – 0.007 inch/inch/minute (0.003 – 0.007 mm/mm/minute) through the yield strength and at 0.03 – 0.07 inch/inch/minute (0.03 – 0.07 mm/mm/minute) above the yield strength.

Tensile Strength, minimum	75,000 psi (517 MPa)
Yield Strength at 0.2% Offset, minimum	60,000 psi (414 MPa)
Elongation in 1 Inch (25.4 mm), minimum	15%

3.4.1.2 At 2200°F (1204°C): Product 0.010 – 0.060 inch (0.025 – 1.52 mm), incl, in nominal thickness shall meet the following requirements when heated to 2200°F ± 10 (1204°C ± 6) under vacuum (less than 0.1 micron mercury) or an inert atmosphere, held at heat for 15 minutes before testing, and tested at 2200°F ± 10 (1204°C ± 6) at a strain rate of 0.03 – 0.07 inch/inch/minute (0.03 – 0.07 mm/mm/minute) in accordance with ASTM E 21:

Tensile Strength, minimum	30,000 psi (207 MPa)
Yield Strength at 0.2% Offset, minimum	25,000 psi (172 MPa)
Elongation in 1 Inch, minimum	15%

3.4.2 Hardness: Shall be not higher than 225 HV30, or equivalent, determined in accordance with ASTM E 92.

3.4.3 Bending: Product shall withstand, without cracking, bending at room temperature in accordance with ASTM E 290 through the angle indicated below around a diameter equal to two times the nominal thickness of the product, with the axis of bend parallel to the direction of rolling.

Nominal Thickness		Angle
Inches	Millimeters	deg, min
0.001 to 0.060, incl	0.025 to 1.52, incl	180
Over 0.060	over 1.52	90

3.4.4 Microstructure: Product shall show a structure consisting essentially of recrystallized grains; standards for acceptance shall be as agreed upon by purchaser and vendor.

3.5 Quality: 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.

3.6 Tolerances: Shall conform to all applicable requirements of AMS-2242 or MAM-2242, except flatness shall conform to the following:

3.6.1 Flatness: When measured using a straight-edge touching the product at two points, the perpendicular distance from the straight-edge to the sheet or plate shall not exceed 0.05 x L inches (millimetres) at any point between the two points of contact, where "L" is the distance in inches (mm) between the two points of contact.

4. QUALITY ASSURANCE PROVISIONS:

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

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for composition (3.1), room temperature tensile Ø properties (3.4.1.1), hardness (3.4.2), bending (3.4.3), microstructure (3.4.4), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests for elevated temperature tensile properties Ø (3.4.1.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing: Shall be in accordance with the following; a lot Ø shall be all product of the same nominal thickness from the same heat processed at the same time:

4.3.1 Composition: One sample from each heat, except that for carbon, oxygen, Ø nitrogen, and hydrogen determinations one sample from each lot.

4.3.2 Tensile Properties, Hardness, Bending, and Microstructure Requirements: Ø **One sample from each** lot.

4.3.2.1 Specimens for tensile tests of widths 9 inches (229 mm) and over shall be taken with the axis 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.

4.4 Reports: The vendor of the product shall furnish with each shipment a Ø report showing the results of tests for chemical composition of each heat and for carbon, oxygen, nitrogen, and hydrogen content, tensile properties, hardness, and bending requirements of each lot. This report shall include the purchase order number, lot number, AMS-7851B, size, and quantity.

4.5 Resampling and Retesting: If any specimen used in the above tests fails to Ø meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Shall be in accordance with AMS-2809, except foil shall be Ø identified as specified by purchaser.