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Superseding AMS7851C

Columbium (Niobium) Alloy Foil, Sheet, Strip, and Plate
10W - 2.5Zr
Recrystallized

(Composition similar to UNS R04271)

RATIONALE

AMS7851D results from a Five Year Review and update of this document.

1. SCOPE

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

1.2 Application

This material has been used typically for parts requiring exposure at ultra high-temperatures, but usage is not limited to such applications. Applications in oxidizing atmospheres necessitate a protective coating.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), www.sae.org.

AMS2242 Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate

AMS2809 Identification, Titanium and Titanium Alloy Wrought Products

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E 8 / E 8M Tension Testing of Metallic Materials

ASTM E 21 Elevated Temperature Tension Tests of Metallic Materials

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on this Technical Report, please visit
<http://www.sae.org/technical/standards/AMS7851D>**

ASTM E 290	Bend Testing Material for Ductility
ASTM E 384	Knoop and Vickers Hardness of Metallic Materials
ASTM E 2626	Spectrometric Analysis of Reactive and Refractory Metals

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1. Metallic elements shall be determined by spectrochemical methods in accordance with ASTM E 2626 or by other analytical methods acceptable to purchaser, carbon shall be determined by the combustion method using an infrared detection system; oxygen, nitrogen and hydrogen shall be determined by the inert gas fusion technique, and columbium shall be determined by difference.

TABLE 1 – COMPOSITION

Element	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 (Niobium)	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 to 2400 °F (1204 to 1316 °C) under vacuum of absolute pressure less than 0.1 micron (0.1 μ m) 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 to 0.060 inch (0.25 to 1.52 mm), inclusive, in nominal thickness, shall meet the requirements of 3.4.1.1 and 3.4.1.2.

3.4.1.1 At Room Temperature

Shall be as shown in Table 2 for sheet and strip 0.010 to 0.060 inch (0.25 to 1.52 mm), inclusive, in nominal thickness, determined in accordance with ASTM E 8 / E 8M with the rate of strain set at 0.005 inch/inch/minute (0.005 mm/mm/minute) and maintained within a tolerance of ± 0.002 inch/inch/minute (0.002 mm/mm/minute) through the 0.2% offset yield strain and 0.05 inch/inch/minute (0.05 mm/mm/minute) and maintained within a tolerance of ± 0.02 inch/inch/minute (± 0.02 mm/mm/minute) above the yield strain to fracture.

TABLE 2 – MINIMUM TENSILE PROPERTIES AT ROOM TEMPERATURE

Property	Value
Tensile Strength	75 ksi (517 MPa)
Yield Strength at 0.2% Offset	60 ksi (414 MPa)
Elongation in 1 Inch (25.4 mm)	15%

3.4.1.2 At 2200 °F (1204 °C)

Product 0.010 to 0.060 inch (0.025 to 1.52 mm), inclusive, in nominal thickness shall meet the requirements shown in Table 3 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 set at 0.05 inch/inch/minute (0.05 mm/mm/minute) and maintained within a tolerance of ± 0.02 inch/inch/minute (0.02 mm/mm/minute) in accordance with ASTM E 21.

TABLE 3 – MINIMUM TENSILE PROPERTIES AT 2200 °F (1204 °C)

Property	Value
Tensile Strength	30.0 ksi (207 MPa)
Yield Strength at 0.2% Offset	25.0 ksi (172 MPa)
Elongation in 1 Inch (25.4 mm)	15%

3.4.2 Hardness

Shall be not higher than 225 HV30, or equivalent, determined in accordance with ASTM E 384.

3.4.3 Bending

Product shall have a test sample prepared nominally 0.750 inch (19.06 mm) in width with axis of bending parallel to the direction of rolling. The sample shall be bend tested in conformance with the guided bend test defined in ASTM E 290 through the angle shown in Table 4. The test fixture supports shall have a minimum contact radius of 0.010 inch (0.25 mm) and the plunger shall have a radius equal to one times the nominal thickness. The bent sample shall not show evidence of cracking when examined at 15 to 25X magnification.

TABLE 4 – MINIMUM BEND ANGLE

Nominal Thickness		Angle degree
Inches	Millimeters	
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; additional standards for acceptance shall be as agreed upon by purchaser and vendor (See 8.4).

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 AMS2242, 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 $0.05 \times L$ 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 samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), room temperature tensile 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

Elevated temperature tensile properties (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 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, nitrogen, and hydrogen determinations one sample from each lot.

4.3.2 Tensile Properties, Hardness, Bending, and Microstructure Requirements

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.