

 <i>An SAE International Group</i>	AEROSPACE MATERIAL SPECIFICATION	SAE AMS7855	REV. D
		Issued 1966-03 Reaffirmed 2008-06 Revised 2013-05 Superseding AMS7855C	
Columbium (Niobium) Alloy Bars, Rods, and Wire 10W - 2.5Zr Recrystallized (Composition similar to UNS R04271)			

RATIONALE

AMS7855D results from a Five Year Review and update of this document.

1. SCOPE

1.1 This specification covers a columbium alloy in the form of bars, rods, or wire.

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.

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 Testing of Metallic Materials

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ASTM E 384 Knoop and Vickers Hardness of Metallic Materials

ASTM E 2626 Spectrometric Analysis of Reactive and Refractory Metals

2.3 ANSI Publications

Available from American National Standards Institute, 25 West 43rd Street, New York, NY 10036-8002, Tel: 212-642-4900, www.ansi.org.

ANSI B46.1 Surface Texture (Surface Roughness, Waviness, and Lay)

3. TECHNICAL REQUIREMENTS

3.1 Composition

The product 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, 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 , or by other methods acceptable to purchaser:

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

Hot-cold worked, descaled, and recrystallized or, if specified, hot-cold worked, descaled, recrystallized, and centerless ground.

3.2.1 The surface finish of centerless ground bars shall be 90 microinches or smoother, determined in accordance with ANSI B46.1.

3.3 Heat Treatment

Product shall be recrystallized at a temperature between 2200 and 2400 °F (1204 and 1316 °C) under vacuum (less than 0.1 micron (0.1 μ m) of 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

Shall be in accordance with 3.4.1.1 and 3.4.1.2.

3.4.1.1 At Room Temperature

Round bars, rods, and wires 0.050 to 0.500 inch (1.27 to 12.7 mm), inclusive, in diameter shall conform to the requirements shown in Table 2 determined in accordance with ASTM E 8 / E 8M using 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

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)	20%
Reduction of Area	30%

3.4.1.2 At 2200 °F (1204 °C)

Round bars, rods, and wire 0.050 to 0.500 inch, (1.27 to 12.70 mm), inclusive, in nominal diameter shall meet the requirements of Table 3 when heated to 2200 °F ± 10 (1204 °C ± 6) in vacuum under 0.1 micron of mercury or an inert atmosphere, held at heat for 15 minutes before testing, and tested in accordance with ASTM E 21 at 2200 °F ± 10 (1204 °C ± 6) at a strain rate of 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) .

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

Property	Value
Tensile Strength	25.0 ksi (172 MPa)
Yield Strength at 0.2% Offset	20.0 ksi (138 MPa)
Elongation in 1 Inch (25.4 mm)	20%

3.4.2 Hardness

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

3.4.3 Microstructure

Product recrystallized as in 3.3 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 and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.6 Tolerances

Shall conform to the following:

3.6.1 Hot-Cold Worked and Descaled

3.6.1.1 Round Rod and Wire

Shall be as specified in Table 4.

TABLE 4A - DIAMETER TOLERANCES, ROUND ROD AND WIRE, INCH/POUND UNITS

Nominal Diameter Inches	Tolerance, Inch Plus	Tolerance, Inch Minus	Out of Round, Inch
0.016 to 0.030, incl	0.0005	0.0005	--
Over 0.030 to 0.062, incl	0.001	0.001	--
Over 0.062 to 0.281, incl	0.002	0.002	0.004
Over 0.281 to 0.422, incl	0.010	0.005	0.008
Over 0.422 to 0.625, incl	0.010	0.005	0.012
Over 0.625 to 0.875, incl	0.015	0.005	0.015
Over 0.875 to 1.000, incl	0.020	0.005	0.015
Over 1.000 to 1.375, incl	0.020	0.010	0.018
Over 1.375 to 1.500, incl	0.020	0.015	0.020
Over 1.500 to 1.625, incl	0.025	0.015	0.020
Over 1.625 to 2.000, incl	0.030	0.020	0.025
Over 2.000 to 2.500, incl	0.032	0.032	0.025
Over 2.500 to 3.250, incl	0.032	0.032	0.027
Over 3.250 to 3.500, incl	0.045	0.045	0.040

TABLE 4B - DIAMETER TOLERANCES, ROUND ROD AND WIRE, SI UNITS

Nominal Diameter Millimeters	Tolerance, mm Plus	Tolerance, mm Minus	Out of Round, Millimeters
0.41 to 0.76, incl	0.013	0.013	--
Over 0.76 to 1.57, incl	0.03	0.03	--
Over 1.57 to 7.14, incl	0.05	0.05	0.10
Over 7.14 to 10.72, incl	0.25	0.13	0.20
Over 10.72 to 15.88, incl	0.25	0.13	0.30
Over 15.88 to 22.22, incl	0.38	0.13	0.38
Over 22.22 to 25.40, incl	0.51	0.13	0.38
Over 25.40 to 34.92, incl	0.51	0.25	0.46
Over 34.92 to 38.10, incl	0.51	0.38	0.51
Over 38.10 to 41.28, incl	0.64	0.38	0.51
Over 41.28 to 50.80, incl	0.76	0.51	0.64
Over 50.80 to 63.50, incl	0.81	0.81	0.64
Over 63.50 to 82.55, incl	0.81	0.81	0.69
Over 82.55 to 88.90, incl	1.14	1.14	1.02

3.6.1.2 Square and Rectangular Bar

Shall be as specified in Table 5.

TABLE 5A - TOLERANCES, SQUARE AND RECTANGULAR BAR, INCH/POUND UNITS

Nominal Thickness (T) Inches	Thickness Tolerance, Inch Plus and Minus	Width Tolerance,	Width Tolerance,
		Inch Plus	Inch Minus
0.187 to 0.500, incl	0.10T	10%	0
Over 0.500	0.062	10%	0

TABLE 5B - TOLERANCES, SQUARE AND RECTANGULAR BAR, SI UNITS

Nominal Thickness Millimeters	Thickness Tolerance, mm Plus and Minus	Width Tolerance,	Width Tolerance,
		mm Plus	mm Minus
4.75 to 12.70, incl	0.10T	10%	0
Over 12.70	1.57	10%	0