SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7857B

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Superseding AMS 7857A

Columbium (Niobium) Alloy Bars, Rods, and Extrusions
10Hf - 1.0Ti, Recrystallization Annealed
(Composition similar to UNS R04295)

1. SCOPE:

1.1 Form:

This specification covers a columbium (niobium) alloy in the form of bars, rods, and extrusions.

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, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2809 Identification, Titanium and Titanium Alloy Wrought Products

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

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 18	Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 384	Microindentation Hardness of Materials

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the following percentages by weight shown in Table 1. Gaseous elements shall be determined by vacuum fusion gas analysis, carbon shall be determined conductometrically, columbium by difference, and other metallic elements by spectrochemical methods or other analytical methods acceptable to purchaser:

Table 1 - Composition

Element	min	max		Check Analysis (3.1.2) 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 (Niobium)	remainder			

3.1.1 Determination not required for routine acceptance.

3.1.2 Check analysis limits are applicable only to purchaser verification testing; producer's test results shall conform to min and max limits of Table 1.

3.2 Melting Practice: Alloy shall be multiple melted under vacuum, using electron beam or consumable electrode practice.

3.3 Condition:

Hot or cold finished, descaled, and recrystallization annealed.

3.4 Properties:

The product shall conform to the following requirements:

3.4.1 Average Grain Size: Shall be as shown in Table 2, determined by comparison of a polished and etched specimen with the chart in ASTM E 112 (See 8.3):

Table 2 – Grain Size

Nominal Diameter or Least Distance Between Parallel Sides									Average Grain Size
Inches					Millimeters				
	Up	to	2.0, incl			Up	to	51, incl	5 or finer
Over	2.0	to	4.0, incl		Over	51	to	102, incl	4 or finer
Over	4.0				Over	102			3 or finer

3.4.2 Tensile Properties: Shall be as shown in Table 3, determined in accordance with ASTM E 8 or ASTM E 8M:

Table 3 – Minimum Tensile Properties

Property	Value
Tensile Strength	54 ksi (372 MPa)
Yield Strength at 0.2% Offset	35.0 ksi (241 MPa)
Elongation in 4D	15%
Reduction of Area	30%

3.4.3 Hardness: Shall be not higher than 95 HRB, or equivalent, determined in accordance with ASTM E 18, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met on a specimen with similar nonconforming hardness.

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

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

3.4.4.2 Surface Contamination: Product shall be free from surface contamination; a difference in hardness of 50 or more points HK100, 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 construed as evidence of surface contamination.

3.4.4.3 Recrystallization: Product shall exhibit not less than 95% recrystallization.

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.

3.5.1 Surfaces of product shall be visually free from oxide or other contamination. Pits, scratches, or gouges are acceptable provided 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 3.6 are met.

3.6 Tolerances: Shall be as follows:

3.6.1 Round Bars and Rods: Shall be as shown in Table 4.

Table 4A – Diameter Tolerances, Round Bars and Rods, Inch/Pound Units

Nominal Diameter Inches	Tolerance, Inch plus	Tolerance, Inch minus	Out of Round Inch
0.62 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 Bars and Rods, SI Units

Nominal Diameter Millimeters	Tolerance, mm plus	Tolerance, mm minus	Out of Round mm
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

3.6.2 Square and Rectangular Bars and Rods:

3.6.2.1 Thickness: Shall be as shown in Table 5:

Table 5 – Thickness Tolerances, Square and Rectangular Bars

Nominal Thickness (T) Inches	Nominal Thickness (T) Millimeters	Tolerance Plus and Minus Inch	Tolerance Plus and Minus Millimeters
0.187 to 0.500, incl	4.75 to 12.70, incl	0.10T	0.10T
Over 0.500	Over 12.70	0.062	1.57

3.6.2.2 Width: Shall be +10%, -0.

3.6.3 Extrusions: Shall be as agreed upon by purchaser and vendor.

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 sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.