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

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-7857 REV A

Issued 1980-04-15
Revised 1991-01-01

Superseding AMS-7857

Submitted for recognition as an American National Standard

COLUMBIUM ALLOY BARS, RODS, AND EXTRUSIONS
10Hf - 1.0Ti
Recrystallization Annealed

UNS R04295

1. SCOPE:

1.1 Form: This specification covers a columbium alloy in the form of bars, rods, and extrusions.

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-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 18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112 - Determining of Average Grain Size
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:

3.1 Composition: Shall conform to the following percentages by weight; 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:

		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)	--	0.3		None
Columbium		remainder			

3.1.1 Determination not required for routine acceptance.

3.2 Condition: Hot or cold worked, descaled, and recrystallization annealed.

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:

Nominal Diameter or Least Distance Between Parallel Sides		Predominant Grain Size	Occasional Grains
Inches	Millimetres		
Up to 2.0, incl	Up to 51, incl	5 or finer	3
Over 2.0 to 4.0, incl	Over 51 to 102, incl	4 or finer	2
Over 4.0	Over 102	3 or finer	1

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

Tensile Strength, minimum	54,000 psi (372 MPa)
Yield Strength at 0.2% Offset, minimum	35,000 psi (241 MPa)
Elongation in 4D, minimum	15%
Reduction of Area, minimum	30%

3.3.3 Hardness: Should 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.

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 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.

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

3.4 Quality:

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

3.4.2 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 3.5 are met.

3.4.3 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 Tolerances: Shall be as follows:

3.5.1 Round Bars and Rods: Shall be as shown in Table I.

TABLE I

Nominal Diameter Inches	Tolerance, Inch plus	Tolerance, Inch minus	Out of Round Inch
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 I (SI)

Nominal Diameter Millimetres	Tolerance, Millimetres plus	Tolerance, Millimetres minus	Out of Round Millimetres
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

3.5.2 Square and Rectangular Bars and Rods:

3.5.2.1 Thickness: Shall be as follows:

Nominal Thickness (T) Inches	Nominal Thickness (T) Millimetres	Tolerance Inch	Tolerance Millimetres
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