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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 7857

Issued 4-15-80
Revised 10-1-84

COLUMBIUM ALLOY BARS AND EXTRUSIONS
10Hf - 1.0Ti

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of 10-25-83. It is recommended that this specification not be specified for new designs.

This cover sheet should be attached to the initial issue of the subject specification.

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

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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 and assemblies 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 Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E3 - Preparation of Metallographic Specimens
ASTM E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E112 - Estimating the Average Grain Size of Metals
ASTM E384 - Microhardness of Materials

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 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 spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by 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.

3.2.1 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 in. (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.

3.3 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 E112:

Nominal Diameter or Least Distance Between Parallel Sides		Predominant	Occasional
Inches	(Millimetres)	Grain Size	Grains
Up to 2.0, incl	(Up to 50, incl)	5 or finer	3
Over 2.0 to 4.0, incl	(Over 50 to 100, incl)	4 or finer	2
Over 4.0	(Over 100)	3 or finer	1

3.3.2 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8:

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

3.3.3 Hardness: Should be not higher than 95 HRB or equivalent, determined in accordance with ASTM E18, 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 E3:

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 HK 100, determined in accordance with ASTM E384, between the center of the specimen and a point 0.0015 in. (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 either electron beam or consumable electrode practice.

3.4.2 The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.5 Tolerances: Unless otherwise specified, 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