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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 7852

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

COLUMBIUM ALLOY SHEET, STRIP, AND PLATE
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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COLUMBIUM ALLOY SHEET, STRIP, AND PLATE
10Hf - 1.0Ti

1. SCOPE:

1.1 Form: This specification covers a columbium alloy in the form of sheet, strip, and plate.

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 this 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

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

ASTM B393 - Niobium and Niobium Alloy Strip, Sheet, Foil, and Plate
ASTM E3 - Preparation of Metallographic Specimens
ASTM E8 - Tension Testing of Metallic Materials
ASTM E112 - Estimating the Average Grain Size of Metals
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials
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 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)	--	0.30	None
Columbium	remainder		

3.1.1 Determination not required for routine acceptance.

3.2 Condition: Cold rolled or hot-cold rolled, descaled, and recrystallized.

3.2.1 Surfaces shall be visually free from oxide or other contamination and shall have a surface appearance comparable to a commercial corrosion-resistant steel No. 1 finish. Standards for acceptance shall be as agreed upon by purchaser and vendor.

3.2.2 Pits, scratches, or gouges are acceptable if 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 maintained.

3.2.3 Burr height on any edge shall not exceed 5% of the nominal thickness.

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:

3.3.1.1 Sheet and Strip Under 0.160 In. (4 mm) in Nominal Thickness: Predominantly 5 or finer with occasional grains as large as 3 permissible.

3.3.1.2 Product 0.160 to 0.750 In. (4 to 19 mm), Incl, in Nominal Thickness: Predominantly 3 or finer with occasional grains as large as 1 permissible.

3.3.1.3 Plate Over 0.750 In. (19 mm) in Nominal Thickness: As agreed upon by purchaser and vendor.

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

	Nominal Thickness	
	Up to 0.125 in. (3.18 mm), Incl	Over 0.125 in. (3.18 mm)
Tensile Strength, min	54,000 psi (372 MPa)	54,000 psi (372 MPa)
Yield Strength at 0.2% offset, min	40,000 psi (276 MPa)	38,000 psi (262 MPa)
Elongation in 1 in. (25 mm) or 4D, min	20%	20%

3.3.3 Bending: The product shall withstand, without fracture, bending in accordance with ASTM E290 at 64° - 84°F (18° - 30°C) through an angle of 105 deg around the diameters indicated in 3.3.3.1 or 3.3.3.2 with axis of bend parallel to the direction of rolling. Speed of the ram shall be not less than 1.0 in. (25 mm) per minute.

3.3.3.1 Sheet and Strip 0.060 in. (1.50 mm) and Under in Nominal Thickness: Diameter equal to nominal thickness.

3.3.3.2 Product Over 0.060 in. (1.50 mm) in Nominal Thickness: Diameter equal to twice the nominal thickness.

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 points or more 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 evidence of surface contamination.

3.3.4.3 Recrystallization: Product shall show evidence of recrystallization as follows:

Nominal Thickness		Minimum Extent of Recrystallization
Inch	(Millimetres)	
Up to 0.150, incl	(Up to 3.81, incl)	95%
Over 0.150 to 0.250, incl	(Over 3.81 to 6.35, incl)	90%
Over 0.250 to 1.000, incl	(Over 6.35 to 25.40, incl)	85%

3.3.4.3.1 Recrystallization requirements for plate over 1.000 in. (25.40 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4 Quality:

3.4.1 Alloy shall be multiple vacuum melted 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 conform to all applicable requirements of ASTM B393.

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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests: Test to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.

4.3 Sampling: Shall be in accordance with the following; a lot shall be all product of the same nominal thickness from the same heat of alloy processed at the same time and presented for vendor's inspection at one time:

4.3.1 Tensile Properties: Not less than two specimens from each lot.

4.3.1.1 Specimens for tensile tests of widths 9 in. (225 mm) and over shall be taken with the axis of the specimen perpendicular to the direction of rolling; for widths less than 9 in. (225 mm), specimens shall be taken with the axis parallel to the direction of rolling.

4.3.2 Bending: Not less than one specimen from each lot.

4.3.3 Microstructure: Not less than two specimens from each lot.

4.4 Reports: