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Superseding AMS7852B	

Columbium (Niobium) Alloy Sheet, Strip, and Plate,
10Hf - 1.0Ti
(Composition Similar to UNS R04295)

RATIONALE

AMS7852C results from a Five Year Review and update of this document

1. SCOPE

1.1 Form

This specification covers a columbium (niobium) alloy in the form of sheet, strip, and plate.

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.

AMS2242 Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate

AMS2809 Identification, Titanium and Titanium Alloy Wrought Products

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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 3	Preparation of Metallographic Specimens
ASTM E 8 / E 8M	Tension Testing of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 290	Bend Testing Material for Ductility
ASTM E 384	Knoop and Vickers Hardness of Materials
ASTM E 2626	Spectrometric Analysis of Reactive and Refractory Metals

3. TECHNICAL REQUIREMENTS

3.1 Composition

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 or by other analytical methods acceptable to purchaser, 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 and columbium shall be determined by difference.

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 vacuum melted using electron beam or consumable electrode practice.

3.3 Condition

Cold rolled or hot-cold rolled, descaled, and recrystallized.

3.4 Properties

The product shall conform to the following requirements:

3.4.1 Average Grain Size

Shall be as follows, determined by comparison of a polished and etched specimen with the chart in ASTM E 112:

3.4.1.1 Sheet and Strip Under 0.160 Inch (4.06 mm) in Nominal Thickness

Predominantly 5 or finer .

3.4.1.2 Product 0.160 to 0.750 Inch (4.06 to 19.05 mm) Inclusive in Nominal Thickness

Predominantly 3 or finer .

3.4.2 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 / E 8M.

TABLE 2A – MINIMUM TENSILE PROPERTIES, INCH/POUND UNITS

Nominal Thickness, Inches	Tensile Strength, ksi	Yield Strength at 0.2% Offset, ksi	Elongation in 1 inch, %
Up to 0.125, incl	54	40.0	20
Over 0.125	54	38.0	20

TABLE 2B - MINIMUM TENSILE PROPERTIES, SI UNITS

Nominal Thickness, Millimeters	Tensile Strength, MPa	Yield Strength at 0.2% Offset, MPa	Elongation in 25.4 mm, %
Up to 3.18, incl	372	276	20
Over 3.18	372	262	20

3.4.3 Bending

Product shall have a test sample prepared nominally 0.750 inch (19.06 mm) in width with axis of bending parallel to the direction of rolling. The sample shall be bend tested in conformance with the guided bend test defined in ASTM E 290 at 64 to 84 °F (18 to 29 °C) through an angle of 105 degrees with the speed of bending not less than 1.0 inch (25 mm) per minute. The test fixture supports shall have a minimum contact radius of 0.010 inch (0.25 mm) and the plunger shall have a radius equal to the bend factor shown in Table 3 times the nominal thickness. The bent sample shall not show evidence of cracking when examined at 15 to 25X magnification.

TABLE 3 - BEND FACTOR

Nominal Thickness, Inch	Nominal Thickness, Millimeters	Bend Factor
Up to 0.060, incl	Up to 1.52, incl	0.5
Over 0.060	Over 1.52	1.0

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 points or more 100HK, 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 evidence of surface contamination.

3.4.4.3 Recrystallization

Product shall show recrystallization to the extent specified in Table 4:

TABLE 4 - MINIMUM RECRYSTALLIZATION

Nominal Thickness Inches	Nominal Thickness Millimeters	Recrystallization, %
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

3.5 Quality

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

3.5.1 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 (See 8.4). Additional standards for acceptance shall be as agreed upon by purchaser and vendor (See 8.5).

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

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

3.6 Tolerances

Shall conform to all applicable requirements of AMS2242.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspections

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 lot.

4.3 Sampling and Testing

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.