

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 4958C

Issued 1988-04
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Superseding AMS 4958B

Titanium Alloy Bars and Rods
3Al - 8V - 6Cr - 4Mo - 4Zr
Consumable Electrode Melted
Solution Heat Treated and Centerless Ground

(Composition similar to UNS R58640)

RATIONALE

AMS 4958C results from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a titanium alloy in the form of bars and rods 1.00 inch (25.4 mm) and under in nominal diameter.

1.2 Application

These products have been used typically for coil springs requiring low solid height, high tensile strength, and corrosion resistance, but usage is not limited to such applications.

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

AMS 2249	Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2368	Sampling and Testing of Wrought Titanium Raw Material Except Forgings and Forging Stock
AMS 2750	Pyrometry
AMS 2809	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 8	Tension Testing of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 1409	Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1417	Liquid Penetrant Testing
ASTM E 1447	Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity/Infrared Detection Method
ASTM E 1941	Determination of Carbon in Refractory and Reactive Metals and Their Alloys
ASTM E 2371	Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry

2.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org

ASME B46.1 Surface Texture (Surface Roughness, Waviness and Lay)

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1; carbon shall be determined in accordance with ASTM E 1941, hydrogen in accordance with ASTM E 1447, oxygen and nitrogen in accordance with ASTM E 1409, and other elements in accordance with ASTM E 2371. Other analytical methods may be used if acceptable to the purchaser.

TABLE 1 - COMPOSITION

Element	min	max
Aluminum	3.00	4.00
Vanadium	7.50	8.50
Chromium	5.50	6.50
Molybdenum	3.50	4.50
Zirconium	3.50	4.50
Iron	--	0.30
Oxygen	--	0.12
Carbon	--	0.05
Nitrogen	--	0.03
Hydrogen (3.1.2)	--	0.030 (300 ppm)
Yttrium (3.1.1)	--	0.005 (50 ppm)
Other Elements, each (3.1.1)	--	0.15
Other Elements, total (3.1.1)	--	0.40
Titanium	remainder	

3.1.1 Determination not required for routine acceptance.

3.1.2 Sample size when using ASTM E 1447 for hydrogen determination may be as large as 0.35 gram.

3.1.3 Check Analysis

Composition variations shall meet the applicable requirements of AMS 2249.

3.2 Melting Practice

3.2.1 Alloy shall be multiple melted. Melting cycles prior to final melting shall be made using vacuum consumable electrode, nonconsumable electrode, electron beam cold hearth, or plasma arc cold hearth melting practice. The final melting cycle shall be made under vacuum using vacuum arc (VAR) electrode practice with no alloying additions permitted.

3.2.1.1 The atmosphere for nonconsumable electrode melting shall be vacuum or shall be argon and/or helium at an absolute pressure not higher than 1000 mm of mercury.

3.2.1.2 The electrode tip for nonconsumable electrode melting shall be water-cooled copper.

3.3 Condition

Hot rolled, solution heat treated, and centerless ground. The product shall be centerless ground to size after solution heat treatment followed by cleaning and an acid pickle with not less than 0.0005 inch (12.7 μ m) overall stock removal. The solution heat treated product may be cold worked, not exceeding 5% total reduction, for sizing purposes prior to centerless grinding and acid pickling. It shall have a surface texture not greater than 63 RMS, determined in accordance with ASME B46.1.

3.4 Heat Treatment

Product shall be solution heat treated by heating to a temperature within the range 1450 to 1600 °F (788 to 871 °C), holding at the selected temperature within ± 25 °F (± 14 °C) for sufficient time for solution heat treatment, and cooling at a rate equivalent to an air cool or faster. Pyrometry shall be in accordance with AMS 2750.

3.5 Properties

Product shall conform to the following requirements:

3.5.1 As Solution Heat Treated

3.5.1.1 Coiling

Product shall show a uniform pitch when wound 2 coils minimum on an arbor having less than or equal to the diameter specified in Table 2. All surfaces of the coil test shall be visually inspected at 8-12X magnification for the existence of cracks and seams. The test piece shall be extended as required to allow inspection of the coils.

TABLE 2A COILING REQUIREMENTS, INCH/POUND UNITS

Wire Diameter, Inches	Mandrel Diameter, Inches
Up to 0.125, incl	0.250
Over 0.125 to 0.187, incl	0.375
Over 0.187 to 0.250, incl	0.500
Over 0.250 to 0.312, incl	0.625
Over 0.312 to 0.375, incl	0.750
Over 0.375 to 0.435, incl	0.875
Over 0.435 to 0.500, incl	1.000
Over 0.500 to 0.560, incl	1.125
Over 0.560 to 0.625, incl	1.250
Over 0.625 to 0.690, incl	1.375
Over 0.690 to 0.750, incl	1.500
Over 0.750 to 0.815, incl	1.625
Over 0.815 to 0.875, incl	1.750
Over 0.875 to 0.940, incl	1.875
Over 0.940 to 1.000, incl	2.000

TABLE 2B COILING REQUIREMENTS, SI UNITS

Wire Diameter, Millimeters	Mandrel Diameter, Millimeters
Up to 3.18, incl	6.35
Over 3.18 to 4.75, incl	9.53
Over 4.75 to 6.35, incl	12.70
Over 6.35 to 7.92, incl	15.88
Over 7.92 to 9.53, incl	19.05
Over 9.53 to 11.05, incl	22.23
Over 11.05 to 12.70, incl	25.40
Over 12.70 to 14.22, incl	28.58
Over 14.22 to 15.88, incl	31.75
Over 15.88 to 17.53, incl	34.93
Over 17.53 to 19.05, incl	38.10
Over 19.05 to 20.70, incl	41.28
Over 20.70 to 22.23, incl	44.45
Over 22.23 to 23.88, incl	47.63
Over 23.88 to 25.40, incl	50.80

3.5.1.2 Average Grain Size

Shall be as follows, determined in accordance with ASTM E 112:

3.5.1.2.1 Product 0.625 Inch (15.88 mm) and Under in Nominal Diameter

ASTM 5 or finer.

3.5.1.2.2 Product Over 0.625 to 1.00 Inch (15.88 to 25.4 mm), Inclusive in Nominal Diameter

ASTM 3 or finer.

3.5.2 After Aging

Product shall have the following properties after being aged by heating to a temperature within the range 850 to 1050 °F (454 to 566 °C), holding at the selected temperature within ± 10 °F (± 6 °C) for 6 to 30 hours, and cooling in air.

3.5.2.1 Tensile Properties

Shall be as shown in Table 3, determined in accordance with ASTM E 8:

TABLE 3 - MINIMUM TENSILE PROPERTIES

Property	Value
Tensile Strength	180 ksi (1241 MPa)
Elongation in 4D	8%
Reduction of Area	20%

3.6 Quality

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.

3.6.1 Product shall have a smooth finish free from pits and abrasions, shall be cylindrical, clean, even uniform cast, and free from kinks, twists, scrapes, splits, and other imperfections.

3.6.2 Bars and rods shall be nondestructively inspected by fluorescent penetrant inspection in accordance with ASTM E 1417 or by electromagnetic (eddy current) inspection. Cracks and other surface defects are not acceptable.