

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4958A

Issued 4-1-88
Revised 7-1-89

Superseding AMS 4958

TITANIUM ALLOY BARS AND RODS
3Al - 8V - 6Cr - 4Mo - 4Zr
Consumable Electrode Melted
Solution Heat Treated and Centerless Ground

UNS R58640

1. SCOPE:

- 1.1 Form: This specification covers a titanium alloy in the form of bars and rods 1.000 inch (25.40 mm) and under in nominal diameter.
- 1.2 Application: Primarily for coil springs requiring low solid height, high tensile strength, and corrosion resistance.

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 documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2249 - Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2809 - Identification, Titanium and Titanium Alloy Wrought Products

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM E8 - Tension Testing of Metallic Materials
ASTM E8M - Tension Testing of Metallic Materials (Metric)
ASTM E112 - Determining Average Grain Size
ASTM E120 - Chemical Analysis of Titanium and Titanium Alloys

SAE Technical Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any particular infringement arising therefrom, is the sole responsibility of the user."

AMS documents are protected under United States and international copyright laws. Reproduction of these documents by any means is strictly prohibited without the written consent of the publisher.

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

2.3.1 Military Specifications:

MIL-H-81200 - Heat Treatment Titanium and Titanium Alloys

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

2.4 ANSI Publications: Available from American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.

ANSI B46.1 - Surface Textures

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E120, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	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	--	0.030 (300 ppm)
Yttrium (3.1.1)	--	0.005 (50 ppm)
Residual Elements, each (3.1.1)	--	0.15
Residual Elements, total (3.1.1)	--	0.40
Titanium	remainder	

3.1.1 Determination not required for routine acceptance.

3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS 2249.

3.2 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 ANSI B46.1.

3.3 Heat Treatment: Product shall be solution heat treated by heating to a temperature within the range 1450° - 1600°F (788° - 871°C), holding at the selected temperature within $\pm 25^\circ\text{F}$ ($\pm 14^\circ\text{C}$) for sufficient time for solution heat treatment, and cooling at a rate equivalent to an air cool or faster. Furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-81200.

3.4 Properties: Product shall conform to the following requirements:

3.4.1 As Solution Heat Treated:

3.4.1.1 Wrapping: Product shall withstand, without cracking, wrapping at room temperature one full turn around a diameter equal to the nominal diameter of the product.

3.4.1.2 Coiling: Product shall show a uniform pitch with no splits or fractures when wound in a tightly closed coil 5 inches (127 mm) long on an arbor having a diameter as specified in Table I and the resultant coil stretched to a permanent set of four times its wound length.

TABLE I

Nominal Diameter (D) Inch	Arbor Diameter Inch
Up to 0.034, incl	0.102
Over 0.034 to 0.045, incl	0.145
Over 0.045 to 0.055, incl	0.212
Over 0.055 to 0.125, incl	0.250
Over 0.125 to 1.000, incl	2D

TABLE I (SI)

Nominal Diameter (D) Millimetres	Arbor Diameter Millimetres
Up to 0.86, incl	2.59
Over 0.86 to 1.14, incl	3.68
Over 1.14 to 1.40, incl	5.38
Over 1.40 to 3.18, incl	6.35
Over 3.18 to 25.40, incl	2D

3.4.1.3 Grain Size: Shall be as follows, determined in accordance with ASTM E112:

3.4.1.3.1 Product 0.625 Inch (15.88 mm) and Under in Nominal Diameter: Average grain size of ASTM 5 or finer with occasional grains of ASTM 3 permissible.

3.4.1.3.2 Product Over 0.625 to 1.00 Inch (15.88 - 25.4mm), Incl, in Nominal Diameter: Average grain size of ASTM 3 or finer.

3.4.2 After Aging: Product shall have the following properties after being aged by heating to a temperature within the range 850° - 1050°F (454° - 566°C), holding at the selected temperature within $\pm 10^\circ\text{F}$ ($\pm 6^\circ\text{C}$) for 6 - 20 hours, and cooling in air.

3.4.2.1 Tensile Properties: Shall be as follows, determined in accordance with
0 ASTM E8 or ASTM E8M:

Tensile Strength, minimum	180,000 psi (1241 MPa)
Elongation in 4D, minimum	8%
Reduction of Area, minimum	20%

3.5 Quality:

3.5.1 Alloy shall be produced by multiple melting using consumable electrode practice. At least one of the melting cycles shall be under vacuum.

3.5.2 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.

3.5.2.1 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.

3.5.2.2 Bars and rods shall be nondestructively inspected by fluorescent penetrant inspection in accordance with AMS 2645 or by electromagnetic (eddy current) inspection. Cracks and other surface defects are not acceptable.

3.6 Tolerances: Shall conform to 3.6.1 and 3.6.2.

3.6.1 Diameter:

TABLE II

Nominal Diameter Inch	Tolerance, Inch Plus and Minus
Up to 0.032, incl	0.0005
Over 0.032 to 0.042, incl	0.00075
Over 0.042 to 0.312, incl	0.001
Over 0.312 to 1.000, incl	0.0015

TABLE II (SI)

Nominal Diameter Millimetres	Tolerance, Millimetre Plus and Minus
Up to 0.81, incl	0.013
Over 0.81 to 1.07, incl	0.0190
Over 1.07 to 7.92, incl	0.025
Over 7.92 to 25.40, incl	0.038