

# AEROSPACE MATERIAL SPECIFICATION



AMS 4958B

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Superseding AMS 4958A

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

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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

### 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials, Metric
ASTM E 112	Determining Average Grain Size
ASTM E 120	Chemical Analysis of Titanium and Titanium Alloys
ASTM E 1409	Determination of Oxygen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1417	Liquid Penetrant Inspection
ASTM E 1447	Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity Method

## 2.3 ASME Publications:

Available from ASME, Order/Inquiries, P.O. Box 2300, Fairfield, NJ 07007-2300 or [www.asme.org](http://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; oxygen shall be determined in accordance with ASTM E 1409, hydrogen in accordance with ASTM E 1447, and other elements by wet chemical methods in accordance with ASTM E 120, by spectrochemical methods, or by other analytical methods 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)
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 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 consumable electrode, nonconsumable electrode, electron beam, or plasma arc melting practices. The final melting cycle shall be made under vacuum using consumable 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  $\mu$ 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  $\pm 25$  °F ( $\pm 14$  °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 Wrapping: Product shall withstand, without cracking, wrapping at room temperature one full turn around a diameter equal to the nominal diameter of the product.
- 3.5.1.2 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 2 and the resultant coil stretched to a permanent set of four times its wound length.

TABLE 2A - Coiling Requirements (Inch-Pound Units)

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 2B - Coiling Requirements (SI Units)

Nominal Diameter (D) Millimeters	Arbor Diameter Millimeters
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

- 3.5.1.3 Average Grain Size: Shall be as follows, determined in accordance with ASTM E 112:

- 3.5.1.3.1 Product 0.625 Inch (15.88 mm) and Under in Nominal Diameter: ASTM 5 or finer (see 8.2).
- 3.5.1.3.2 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  $\pm 10$  °F ( $\pm 6$  °C) for 6 to 20 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 or ASTM E 8M:

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.

### 3.7 Tolerances:

Shall conform to 3.7.1 and 3.7.2.

#### 3.7.1 Diameter:

TABLE 4A - Tolerances, Inch-Pound Units

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 4B - Tolerances, SI Units

Nominal Diameter Millimeters	Tolerance, Millimeter Plus and Minus
Up to 0.81, incl	0.013
Over 0.81 to 1.07, incl	0.019
Over 1.07 to 7.92, incl	0.025
Over 7.92 to 25.40, incl	0.038

3.7.2 Length Tolerance: Straight lengths shall vary not more than +2.0 inches (+51 mm), -0.

#### 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 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 the specified requirements.

##### 4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

##### 4.3 Sampling and Testing:

Shall be in accordance with AMS 2368 and the following:

##### 4.3.1 Tensile Properties: Two samples from each lot.