

Submitted for recognition as an American National Standard

TITANIUM ALLOY BARS AND WIRE  
3Al - 8V - 6Cr - 4Mo - 4Zr  
Consumable Electrode Melted  
Cold Drawn

UNS R58640

1. SCOPE:

1.1 Form:

This specification covers a titanium alloy in the form of bars and wire 0.625 inch (15.88 mm) and under in nominal diameter or thickness.

1.1.1 Bars and wire are defined in ARP1917.

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.

1.3 Classification:

Bars and wire shall be classified as follow:

- Type 1 -- Centerless ground
- Type 2 -- As drawn

1.3.1 Either Type 1 or Type 2 may be supplied unless a specific type is ordered.

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 publications shall be the issue in effect on the date of the purchase order.

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## 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2241 Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy,  
Titanium, and Titanium Alloy Bars and Wire  
MAM 2241 Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy,  
Titanium, and Titanium Alloy Bars and Wire  
AMS 2249 Chemical Check Analysis Limits, Titanium and Titanium Alloys  
AMS 2631 Ultrasonic Inspection, Titanium and Titanium Alloy Bar and Billet  
AMS 2645 Fluorescent Penetrant Inspection  
AMS 2750 Pyrometry  
AMS 2809 Identification, Titanium and Titanium Alloy Wrought Products  
ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

## 2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM E 8 Tension Testing of Metallic Materials  
ASTM E 8M Tension Testing of Metallic Materials (Metric)  
ASTM E 112 Determining the Average Grain Size  
ASTM E 120 Chemical Analysis of Titanium and Titanium Alloys

## 2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

## 2.4 ANSI Publications:

Available from American National Standards Institute, Inc., 11 West 42nd Street, New York, NY 10036.

ANSI B46.1 Surface Texture

## 3. TECHNICAL REQUIREMENTS:

### 3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 120, by spectrochemical methods, or by other analytical methods acceptable to 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	--	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 (R) AMS 2249; no variation over maximum will be permitted for yttrium.

3.2 Melting Practice:

Alloy shall be multiple melted using consumable electrode practice. The final melting cycle shall be under vacuum.

3.3 Condition:

(R)

Cold drawn with 20 to 35% final reduction in coils or straight lengths, as specified. Product ordered in coil form shall be coated with a lubricant suitable for use on automatic spring winding machines.

3.3.1 Type 1: Shall be centerless ground, cleaned, and acid pickled with not less than 0.0005 inch (12.7  $\mu\text{m}$ ) overall stock removal. It shall have a surface texture not greater than 63 RMS, determined in accordance with ANSI B46.1.

3.3.2 Type 2: Shall be as drawn, cleaned, and acid pickled with not less than 0.0005 inch (12.7  $\mu\text{m}$ ) overall stock removal.

3.4 Properties:

The product shall conform to the following requirements:

## 3.4.1 As Cold Drawn:

- 3.4.1.1 Wrapping: Product under 0.312 inch (7.92 mm) in nominal diameter 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 2 and the resultant coil stretched to a permanent set of four times its wound length.

TABLE 2A - Diameter/Thickness vs Arbor Diameter, Inch/Pound Units

Nominal Diameter (D) or Least Distance Between Parallel Sides 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 0.625, incl	2D

TABLE 2B - Diameter/Thickness vs Arbor Diameter, SI Units

Nominal Diameter (D) or Least Distance Between Parallel Sides 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 15.88, incl	2D

- 3.4.2 After Aging: The product shall have the following properties after being aged by heating to a temperature within the range 950 to 1050 °F (510 to 566 °C), holding at the selected temperature within  $\pm 10$  °F ( $\pm 6$  °C) for 6 to 10 hours, and cooling in air. Pyrometry shall be in accordance with AMS 2750.

3.4.2.1 Tensile Properties: Shall be as shown in Table 3, determined in accordance with ASTM E 8 or ASTM E 8M, as applicable.

TABLE 3A - Tensile Properties, Inch/Pound Units

Nominal Diameter or Least Distance Between Parallel Sides Inch	Tensile Strength ksi	Elongation in 4D %, min	Reduction of Area %, min
Up to 0.187, incl	190 - 210	10	20
Over 0.187 to 0.375, incl	185 - 205	10	20
Over 0.375 to 0.625, incl	180 - 200	8	20

TABLE 3B - Tensile Properties, SI Units

Nominal Diameter or Least Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Elongation in 4D %, min	Reduction of Area %, min
Up to 4.75, incl	1310 - 1448	10	20
Over 4.75 to 9.52, incl	1276 - 1413	10	20
Over 9.52 to 15.88, incl	1241 - 1379	8	20

3.4.2.2 Grain Size: Product shall exhibit uniform microstructure with an average (R) grain size of ASTM No. 5 or finer, determined in accordance with ASTM E 112.

### 3.5 Quality:

The 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.

3.5.1 The product shall have a smooth finish free from pits and abrasions and (R) shall be clean, uniform cast, and free from kinks, twists, scrapes, splits, and other imperfections.

3.5.2 Type 1 bars and wire shall be nondestructively inspected by fluorescent penetrant inspection in accordance with AMS 2645 or by electromagnetic (eddy current) inspection. Cracks or other surface ruptures are not acceptable.