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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4957

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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 in. (15.50 mm) and under in nominal diameter or thickness.

1.2 Application: Primarily for coil springs requiring low solid height, high tensile strength, and corrosion resistance.

1.3 Classification: Bars and wire shall be classified as follow:

Type I -- Centerless ground
Type II -- As drawn

1.3.1 Either Type I or Type II 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 Aerospace Material Specifications 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

REAFFIRMED 4-97

Printed in U.S.A.

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

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

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 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 Texture

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E120 or by spectrochemical or other analytical methods approved by 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: Cold drawn with 20 to 35% final reduction. Product ordered in coil form shall be coated with a lubricant suitable for use on automatic spring winding machines.

3.2.1 Type I: Shall be centerless ground, cleaned, and acid pickled with not less than 0.0005 in. (12.5 µm) overall stock removal. It shall have a surface texture not greater than 63 RMS, determined in accordance with ANSI B46.1.

3.2.2 Type II: Shall be as drawn, cleaned, and acid pickled with not less than 0.0005 in. (12.5 µm) overall stock removal.

3.3 Properties: The product shall conform to the following requirements:

3.3.1 As Cold Drawn:

3.3.1.1 Wrapping: Product under 0.312 in. (7.80 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.

3.3.1.2 Coiling: Product shall show a uniform pitch with no splits or fractures when wound in a tightly closed coil 5 in. (125 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) 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 I (SI)

Nominal Diameter (D) or Least Distance Between Parallel Sides Millimetres	Arbor Diameter Millimetres
Up to 0.85, incl	2.55
Over 0.85 to 1.12, incl	3.60
Over 1.12 to 1.38, incl	5.30
Over 1.38 to 3.12, incl	6.25
Over 3.12 to 15.50, incl	2D

3.3.2 After Aging: The product shall have the following properties after being aged by heating to a temperature within the range 950° - 1050°F (510° - 565°C), holding at the selected temperature within ±10°F (±5°C) for 6 - 10 hr, and cooling in air.

3.3.2.1 Tensile Properties: Shall be as specified in Table II, determined in accordance with ASTM E8:

TABLE II

Nominal Diameter or Least Distance Between Parallel Sides Inch	Tensile Strength psi	Elongation in 4D %, min	Reduction of Area %, min
Up to 0.187, incl	190,000 - 210,000	10	20
Over 0.187 to 0.375, incl	185,000 - 205,000	10	20
Over 0.375 to 0.625, incl	180,000 - 200,000	8	20

TABLE II (SI)

Nominal Diameter or Least Distance Between Parallel Sides Millimetres	Tensile Strength MPa	Elongation in 4D %, min	Reduction of Area %, min
Up to 4.75, incl	1310 - 1450	10	20
Over 4.75 to 9.50, incl	1275 - 1415	10	20
Over 9.50 to 15.50, incl	1240 - 1380	8	20

3.3.2.2 Grain Size: Product shall exhibit uniform microstructure with an average grain size of ASTM 5 or finer with occasional grains of ASTM 4 permitted, determined in accordance with ASTM E112.

3.4 Quality:

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

3.4.2 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.

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

3.4.2.2 Type I 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 detected by these methods are not acceptable.

3.5 Tolerances: Shall conform to 3.5.1 and 3.5.2.

3.5.1 Diameter:

TABLE III

Nominal Diameter or Least Distance Between Parallel Sides 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 0.625, incl	0.0015

TABLE III (SI)

Nominal Diameter or Least Distance Between Parallel Sides Millimetres	Tolerance, Millimetre Plus and Minus
Up to 0.80, incl	0.012
Over 0.80 to 1.05, incl	0.019
Over 1.05 to 7.80, incl	0.025
Over 7.80 to 15.50, incl	0.038

3.5.2 Length: Shall vary not more than +2.00 in. (+50 mm), -0 for straight lengths.

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 performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling: Shall be in accordance with the following; a lot shall be all product of the same nominal size from the same heat processed at one time.

4.3.1 Composition: One sample from each heat except that for hydrogen determinations one sample from each lot, obtained after thermal and chemical processing is completed.

4.3.2 Wrapping, Coiling, and Tensile Properties: Two samples from each lot.

4.3.3 Microstructure: One sample from each lot.