SAE The Engineering Society For Advancing Mobility Land Sea Air and Space

400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 4977B

Issued 11-1-69
Revised 4-1-87

Superseding AMS 4977A

TITANIUM ALLOY BARS
11.5Mo - 6.0Zr - 4.5Sn
1275° - 1350°F (690° - 730°C) Solution Heat Treated

UNS R58030

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of 23 October 1985. It is recommended that this specification not be specified for new designs.

This cover sheet should be attached to the "B" revision of the subject specification.

Noncurrent refers to those materials which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division does not recommend these as standard materials for future use in new designs. Each of these "Noncurrent" specifications is available on request.

This specification is under the jurisdiction of AMS Committee "G".

Society of Automotive Engineers, Inc.
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1. SCOPE:

1.1 Form: This specification covers a titanium alloy in the form of bars and wire.

1.2 Application: Primarily for parts where cold formability is desirable or necessary and requiring high strength-to-weight ratio up to 700° F (370° C) after appropriate precipitation heat treatment. Suitable for fasteners and for structures requiring deep hardenability.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2241 - Tolerances, 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 2350 - Standards and Test Methods

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 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 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

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

Printed in U.S.A.

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 spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Molybdenum	10.00 -	13.00
Zirconium	4.50 -	7.50
Tin	3.75 -	5.25
Iron	--	0.35
Oxygen	--	0.18
Carbon	--	0.10
Nitrogen	--	0.05 (500 ppm)
Hydrogen	--	0.015 (150 ppm)
Yttrium	--	0.005 (50 ppm)
Residual Elements, each (3.1.1)	--	0.10
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: The product shall be supplied in the following condition:

3.2.1 Bars: Hot finished with or without subsequent cold reduction, solution heat treated, straightened, and descaled.

3.2.2 Wire: Hot finished with or without subsequent cold reduction, solution heat treated, and descaled.

3.3 Heat Treatment: The product shall be solution heat treated by heating to a temperature within the range 1275° - 1350° F (690° - 730° C), holding at the selected temperature within ± 25°F (±15°C) for 15 - 60 min., and quenching in water.

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

3.4.1 Tensile Properties: Shall be as specified in 3.4.1.1 and 3.4.1.2, determined in accordance with ASTM E8 with the rate of strain maintained at 0.003 - 0.007 in. per in. per min. (0.003 - 0.007 (mm/mm)/min.) through the yield strength and then increased so as to produce failure in approximately one additional minute. When a dispute occurs between purchaser and vendor over the yield strength values, a referee test shall be performed on a machine having a strain rate pacer, using a rate of 0.005 in. per in. per min. (0.005(mm/mm)/min.) through the yield strength and a miniumum cross-head speed of 0.10 in. (2.5 mm) per min. above the yield strength.

3.4.1.1 As Solution Heat Treated: Product 3.000 in. (76.20 mm) and under in nominal diameter or distance between parallel sides shall have the following properties:

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min (See 3.4.1.1.1)	Yield Strength at 0.2% Offset psi, min	Elongation in 4D, %, min	Reduction of Area %, min
Up to 1.625, incl	110,000	90,000	15	50
Over 1.625 to 3.000, incl	100,000	90,000	15	50

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Tensile Strength MPa, min (See 3.4.1.1.1)	Yield Strength at 0.2% Offset MPa, min	Elongation in 4D, %, min	Reduction of Area %, min
Up to 41.28, incl	758	621	15	50
Over 41.28 to 76.20, incl	690	621	15	50

3.4.1.1.1 For cold heading applications, tensile strength shall be not higher than 135,000 psi (931 MPa).

3.4.1.1.2 Tensile property requirements for bars over 3.000 in. (76.20 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.4.1.2 After Precipitation Heat Treatment: Product 1.625 in. (41.28 mm) and under in nominal diameter or distance between parallel sides shall have the following properties after being precipitation heat treated by heating to 1075° F ± 15 (580° C ± 8), holding at heat for not less than 4 hr, and cooling in air and descaled; precipitation heat treatment shall precede final machining of specimens:

Tensile Strength, min	135,000 psi (931 MPa)
Yield Strength at 0.2% Offset, min	130,000 psi (896 MPa)
Elongation in 4D, min	12%
Reduction of Area, min	40%

3.4.1.2.1 Tensile property requirements for bars over 1.625 in. (41.28 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

3.4.1.3 Yield strength and reduction of area requirements do not apply to wire less than 0.125 in. (3.18 mm) in diameter.

3.4.1.4 Ø Tensile properties shall be determined in the long-transverse direction on product from which tensile specimens 2.50 in. (63.5 mm) or greater in length can be obtained.

3.4.1.5 Tests in the longitudinal direction are not required on product tested in the transverse direction.

3.5 Quality:

3.5.1 Ø Alloy shall be produced by multiple melting using consumable electrode practice; the final melting cycle shall be under vacuum.

3.5.2 Ø The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to the usage of the product.