AEROSPACE
MATERIAL SPECIFICATIONS

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York, N.Y. 10017

AMS 4974

Issued 11-1-67
Revised

TITANIUM ALLOY BARS AND FORGINGS
11Sn - 5.0Zr - 2.3Al - 1.0Mo - 0.21Si
Solution and Precipitation Treated

1. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

2. FORMS: Bars, forgings, and forging stock.

3. APPLICATION: Primarily for parts requiring high strength up to 900 F (482 C).

4. COMPOSITION: The product shall conform to the following:

	min	max
Tin	10.50	11.50
Zirconium	4.00	6.00
Aluminum	2.00	2.50
Molybdenum	0.80	1.20
Silicon	0.15	0.27
Oxygen	--	0.15
Iron	--	0.12
Carbon	--	0.04
Nitrogen	--	0.04 (400 ppm)
Hydrogen	--	0.0125 (125 ppm)
Other Elements, total (1)	--	0.40
Titanium	remainder	

(1) Need not be reported.

4.1 Check Analysis: Composition variations shall meet the requirements of the latest issue of AMS 2249.

5. CONDITION:

5.1 Bars and Forgings: Unless otherwise specified, hot finished, solution and precipitation heat treated, and descaled.

5.2 Forging Stock: As ordered by the forging manufacturer.

6. TECHNICAL REQUIREMENTS:

6.1 Bars and Forgings:

6.1.1 Heat Treatment: Unless otherwise permitted, the product shall be solution heat treated by heating to 1650 F ± 25 (898.9 C ± 14), holding at heat for 1 hr, and air cooling, and then precipitation heat treated by heating to 930 F ± 15 (498.9 C ± 8.3), holding at heat for 24 hr, and cooling in air.

SAENORM.COM : Click to view the full PDF of ams4974

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

Copyright 1967 by Society of Automotive Engineers, Inc.

6.1.2 Room Temperature Tensile Properties: Specimens cut from bars and forgings heat treated as in 6.1.1 shall meet the following requirements. These properties apply when the rate of strain is maintained at 0.003 - 0.007 in. per in. per min. through the yield strength, and then is 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 test machine having a strain rate pacer, using a rate of 0.005 in. per in. per min. through the yield strength.

Nominal Diameter or Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation % in 2 in. or 4D min	Reduction of Area (round specimens) %, min
Up to 1.000, incl	145,000	135,000	10	20
Over 1.000 to 2.000, incl	145,000	130,000	10	20
Over 2.000 to 3.000, incl	140,000	130,000	10	20

6.1.2.1 The properties of material over 3.000 in. in diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

6.1.3 Tensile Properties at 800 F (426.7 C): Specimens cut from bars and forgings, heat treated as in 6.1.1, when heated to 800 F ± 10 (426.7 C ± 5.6), held at heat for 30 min. before testing, and tested at 800 F ± 10 (426.7 C ± 5.6) at a strain rate of 0.003 - 0.007 in. per in. per min. to the yield strength, shall be capable of meeting the following requirements.

Nominal Diameter or Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation % in 2 in. or 4D min	Reduction of Area (round specimens) %, min
Up to 1.000, incl	105,000	80,000	15	30
Over 1.000 to 2.000, incl	100,000	80,000	15	30
Over 2.000 to 3.000, incl	95,000	75,000	12	25

6.1.3.1 The properties of material over 3.000 in. in diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

6.1.4 Room Temperature Notched Stress Rupture Test: Specimens taken from bars and forgings shall be capable of meeting the following requirements:

6.1.4.1 A tensile test specimen machined to the dimensions shown in Fig. 1 and Table I, maintained at room temperature while the axial stress indicated below is applied continuously, shall not rupture in less than 5 hours. The initial stress may be less than that specified and increased to the specified stress in increments of 10,000 psi at intervals of not less than 5 hours.

	Stress, psi
Bars under 5 sq in. cross-sectional area and all forgings	165,000
Bars 5 sq in. and over in cross-sectional area	155,000

6.1.5 Stress Rupture Test at 1000 F (537.8 C): When specified, specimens taken from bars and forgings shall be capable of meeting the following requirements:

6.1.5.1 A tensile test specimen, maintained at 1000 F ± 3 (537.8 C ± 1.7) while an axial stress of 70,000 psi is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture. Elongation after rupture, measured at room temperature, shall not be less than 10% in 4D.

6.1.5.1.1 The test of 6.1.5.1 may be conducted at a stress higher than 70,000 psi, but stress shall not be changed while test is in process, unless otherwise specified or allowed. Time to rupture and elongation requirements shall be as specified in 6.1.5.1.

SAENORM.COM : Click to view the full PDF of ams4974

6.1.6 Creep Stability Test: When specified, specimens taken from forgings shall be capable of meeting the following requirement:

6.1.6.1 A tensile test specimen, maintained at 800 F ± 3 (426.7 C ± 1.7) while an axial stress of 70,000 psi is applied continuously for 100 hr, shall show not more than 0.2% creep elongation.

6.2 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 6.1.1, specimens taken from the heat treated coupon shall conform to the requirements of 6.1.2, 6.1.3, 6.1.4, 6.1.5, and 6.1.6. If specimens taken from the stock after heat treatment as in 6.1.1 conform to the requirements of 6.1.2, 6.1.3, 6.1.4, 6.1.5, and 6.1.6 the test shall be accepted as equivalent to tests of the forged coupon.

7. QUALITY: Unless otherwise specified, material shall be produced by multiple melting using consumable electrode practice; at least one of the melting cycles shall be under vacuum. The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

8. TOLERANCES: Unless otherwise specified, tolerances for bars shall conform to all applicable requirements of the latest issue of AMS 2241.

9. REPORTS:

9.1 Unless otherwise specified, the vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment, and the results of tests on each lot to determine conformance to the hydrogen, tensile, and room temperature notched stress-rupture requirements of this specification. A lot is defined as all material of the same nominal size, from the same heat, processed at the same time. When such tests are required, the results of stress rupture tests at 1000 F (537.8 C) and creep stability tests shall be reported. This report shall include the purchase order number, heat number, material specification number, size, and quantity from each heat. If forgings are supplied, the part number and size of stock used to make the forgings shall also be included.

9.2 Unless otherwise specified, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

10. IDENTIFICATION: Unless otherwise specified, the product shall be identified as follows:

10.1 Bars:

10.1.1 Each straight bar 0.500 in. and over in diameter or least width of flat surface shall be marked in a row of characters recurring at intervals not greater than 3 ft with AMS 4974, heat number, and manufacturer's identification. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid whose residue shall contain not more than traces of halogen-bearing compounds, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

10.1.2 Straight bars less than 0.500 in. in diameter or least width of flat surface shall be securely bundled and identified by a metal or plastic tag embossed with the purchase order number, AMS 4974, heat number, nominal size, and manufacturer's identification and attached to each bundle or shall be boxed and the box marked with the same information.

SAENORM.COM : Click to view the full PDF of ams4974

10.2 Forgings: Shall be identified in accordance with the latest issue of AMS 2808.

10.3 Forging Stock: Shall be identified as agreed upon by purchaser and vendor.

11. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection.

SAENORM.COM : Click to view the full PDF of ams4974