

AEROSPACE MATERIAL SPECIFICATIONS

AMS 4968

SOCIETY OF AUTOMOTIVE ENGINEERS, Inc. 485 Lexington Ave., New York 17, N.Y.

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Revised

TITANIUM ALLOY BARS AND FORGINGS 5Zr - 5Al - 5Sn Annealed

1. **ACKNOWLEDGMENT:** A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.
2. **FORM:** Bars, forgings, flash welded rings, and stock for forgings or flash welded rings.
3. **APPLICATION:** Primarily for parts requiring strength up to 900 F (482 C), such as compressor blades, and parts requiring good creep strength, such as bolts.
4. **COMPOSITION:** The product shall conform to the following:

	min	max
Zirconium	4.70	5.70
Aluminum	4.50	5.50
Tin	4.30	5.30
Iron	--	0.15
Oxygen	--	0.12
Carbon	--	0.04
Nitrogen	--	0.030 (300 ppm)
Hydrogen	--	0.013 (130 ppm)
Other Elements, each (1)	--	0.10
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:** Unless otherwise specified, material shall be supplied in the following condition.
 - 5.1 **Bars:** Hot finished, with or without subsequent cold reduction, annealed, and descaled.
 - 5.2 **Forgings:** Annealed and descaled.
 - 5.3 **Flash Welded Rings:** Annealed and descaled.
 - 5.3.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, they shall be manufactured in accordance with the latest issue of AMS 7498, unless otherwise permitted.
 - 5.4 **Stock for Forgings or Flash Welded Rings:** As ordered by the forging or flash welded ring manufacturer.
6. **TECHNICAL REQUIREMENTS:**
 - 6.1 **Annealing:** Unless otherwise specified, the product shall be annealed as follows:
 - 6.1.1 **Bars and Forgings to be Machined All Over:** Heat to 1650 F $\pm$ 25 (898.9 C $\pm$ 14), hold at heat for 4 hr, and air cool.

6.1.2 Forgings Not to be Machined All Over: Heat to $1650\text{ F} \pm 25$ ($898.9\text{ C} \pm 14$), hold at heat for 4 hr, and air cool. Unless otherwise permitted, annealing and cooling from the annealing temperature to below 1100 F (593 C) shall be accomplished in an inert atmosphere.

6.2 Tensile Properties: 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 Distance Between Parallel Sides Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset or at Extension Indicated ($E = 16,000,000$)		Elongation % in 2 in. or 4D, min	Reduction of Area %, min
		psi, min	Extension Under Load in. in 2 in.		
Up to 2.00, incl	120,000	110,000	0.0178	10	25
Over 2.00 to 4.00, incl; 16 sq in. max cross sectional area	110,000	100,000	0.0165	10	20

6.3 Hardness: Shall be not higher than Rockwell C 39 or Brinell 352 or equivalent.

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

6.4.1 A tensile test specimen with a 60 deg V-notch, with area at root of Vee approximately equal to half the area of the full section of specimen and $0.005\text{ in.} \pm 0.0005$ radius of curvature at base of notch, maintained at room temperature while an axial stress of $150,000\text{ psi}$ is applied continuously, shall not rupture in less than 5 hours. The initial stress may be less than $150,000\text{ psi}$ and increased to $150,000\text{ psi}$ in increments of $10,000\text{ psi}$ at intervals of not less than 5 hours.

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 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 for tensile properties of each size from each heat. This report shall include the purchase order number, heat number, material specification number, size, specific annealing treatment used, 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.