Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 4936

Issued 11-15-71
Revised

TITANIUM ALLOY EXTRUSIONS
6Al - 6V - 2Sn

1. SCOPE:

1.1 Form: This specification covers a titanium-base alloy in the form of extruded bars, tubes, shapes, and stock for flash welded rings.

1.2 Application: Primarily for parts that do not require heat treatment but must have high mechanical properties in the annealed condition. This alloy exhibits high strength to weight ratios up to 750 F (399 C). Certain processing procedures and service conditions may cause this material to be subject to stress-corrosion cracking; ARP 982 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specification (AMS) and Aerospace Recommended Practices 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., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2249 - Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2350 - Standards and Test Methods

2.1.2 Aerospace Recommended Practices:

ARP 982 - Minimizing Stress-Corrosion in Wrought Titanium Alloy Products

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

ASTM E8 - Tension Testing of Metallic Materials
ASTM E120 - Chemical Analysis of Titanium and Titanium-Base Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Ave., Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

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

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 approved analytical methods.

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	min	max	
Aluminum	5.00	6.00	
Vanadium	5.00	6.00	
Tin	1.50	2.50	
Iron	0.35	1.00	
Copper	0.35	1.00	
Carbon	--	0.05	
Oxygen	--	0.20	
Nitrogen	--	0.04	(400 ppm)
Hydrogen	--	0.015	(150 ppm)
Other 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, Tubes, and Shapes: Hot finished, with or without subsequent cold reduction, annealed, and descaled.

3.2.2 Stock for Flash Welded Rings: As ordered by the flash welded ring manufacturer.

3.3 Annealing: Bars, tubes, and shapes shall be annealed by heating in suitable atmosphere to a temperature within the range 1300 - 1500 F (704.4 - 815.6 C), holding at the selected temperature within ± 25 F (± 14 C) for 2 hr, and cooling as required.

3.4 Properties:

3.4.1 Tensile Properties: Shall be as specified in Table I, 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 minimum cross head speed of 0.10 in. per min. (2.54 mm per min.) above the yield strength.

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TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi	Elongation in 2 in. or 4D %, min		Reduction of Area %, min	
			L	T	L	T
Up to 1.50, incl	150,000	140,000 - 165,000	10	8	20	15
Over 1.50 to 3.00, incl	145,000	135,000 - 160,000	10	8	20	15
Over 3.00 to 4.00, incl	140,000	130,000 - 155,000	10	8	20	15

TABLE I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tensile Strength MN/m^2, min	Yield Strength at 0.2% Offset MN/m^2	Elongation in 50.8 mm or 4D %, min		Reduction of Area %, min	
			L	T	L	T
Up to 38.10, incl	1034	965 - 1138	10	8	20	15
Over 38.10 to 76.20, incl	1000	931 - 1103	10	8	20	15
Over 76.20 to 101.60, incl	965	896 - 1069	10	8	20	15

3.4.2 Surface Contamination: Material shall be free of any oxygen-rich layer, such as alpha case, or other surface contamination.

3.4.3 Microstructure: Shall be essentially that resulting from beta processing. Microstructure shall not be cause for rejection unless standards have been agreed upon by purchaser and vendor.

3.5 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.

3.6 Tolerances: Unless otherwise specified, tolerances for extruded bars, tubes, shapes, and stock for flash welded rings shall be as agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor shall supply all samples 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 perform such confirmatory testing as he deems necessary to assure 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 routine control tests.

4.3 Sampling: Shall be in accordance with the following; when sampling is on a lot basis, a lot shall be all material of the same nominal size from the same heat processed at the same time.

4.3.1 Composition: One sample from each heat except that for hydrogen determinations one sample from each lot.

4.3.2 Tensile Properties: At least one sample from each lot.

4.3.3 Other Requirements: As agreed upon by purchaser and vendor.

4.4 Reports:

4.4.1 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, the results of tests on each lot to determine conformance to the hydrogen and tensile property requirements, and a statement that the product conforms to all other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number, size, specific annealing treatment used, and quantity from each heat.

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