

**AEROSPACE
MATERIAL
SPECIFICATION**

AMS 4908D
Superseding AMS 4908C

Issued 11-1-52
Revised 10-1-81

UNS R56080

TITANIUM ALLOY SHEET AND STRIP

8Mn

Annealed, 110,000 psi (760 MPa) Yield Strength

1. SCOPE:

1.1 Form: This specification covers a titanium alloy in the form of sheet and strip.

1.2 Application: Primarily for parts requiring good formability and strength up to 600°F (315°C). Certain processing procedures and service conditions may cause these products to become 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 Specifications (AMS) and Aerospace Recommended Practices (ARP) 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 2242 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate

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

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 or their use by governmental agencies 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."

AMS 4908D

- 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
ASTM E290 - Semi-Guided Bend Test for Ductility of Metallic Materials

- 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

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight,
Ø 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
Manganese	6.5	9.0
Iron	--	0.50
Oxygen	--	0.20
Carbon	--	0.08
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: Hot rolled, with or without subsequent cold reduction, annealed, descaled, and leveled, having a surface appearance comparable to a commercial corrosion-resistant steel No. 2D finish.

3.3 Annealing: The product shall be annealed by heating to $1275^{\circ}\text{F} + 25$ ($690^{\circ}\text{C} + 15$), holding at heat for not less than 60 min., cooling to 1050°F (565°C) or lower at a rate not greater than 300 F (150 C) deg per hr, and cooling in air to room temperature.

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

3.4.1 Tensile Properties: Shall be as follows, 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 0.010 in. (2.5 mm) per min. above the yield strength:

Tensile Strength, min	125,000 psi (860 MPa)
Yield Strength at 0.2% Offset, min	110,000 psi (760 MPa)
Elongation in 2 in. (50 mm), min	10%

3.4.1.1 Yield strength, determined with axis of specimen parallel to direction of rolling, shall be not higher than 140,000 psi (965 MPa).

3.4.2 Bending: The product shall withstand, without evidence of cracking when examined at 20X magnification, bending in accordance with ASTM E290 at room temperature through an angle of 105 deg around a diameter equal to the bend factor times the nominal thickness of the product, using either V-block, U-channel, or free bend procedure, with axis of bend parallel to direction of rolling. Only one of these tests will be required in routine inspection. In case of dispute, results of bend tests using the V-block procedure shall govern:

Nominal Thickness		Bend Factor
Inch	(Millimetres)	
Up to 0.070, incl	(Up to 1.75, incl)	6
Over 0.070 to 0.1875, excl	(Over 1.75 to 4.75, excl)	7

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

3.4.4 Surface Contamination: Product shall be free of any oxygen-enriched layer, such as alpha case, or other surface contamination determined as in 3.4.4.1, 3.4.4.2, or other method agreed upon by purchaser and vendor.

3.4.4.1 The bend test of 3.4.2.

3.4.4.2 Microscopic examination at 100X.

3.5 Quality:

3.5.1 Alloy shall be multiple melted; at least one of the melting cycles shall
Ø be under vacuum. The first melt shall be made by either consumable or nonconsumable electrode practice. The subsequent melt or melts shall be made using consumable electrode practice.

3.5.1.1 The atmosphere for nonconsumable electrode melting shall be vacuum or
Ø shall be inert gas at a pressure not higher than 250 mm of mercury.

3.5.1.2 The electrode tip for nonconsumable electrode melting shall be either
Ø graphite or water-cooled copper.

3.5.2 The product, as received by purchaser, shall be uniform in quality and
Ø condition, sound, and free from "oil cans" (See 8.2) of depth in excess of the flatness tolerance, ripples, and foreign materials and from internal and external imperfections detrimental to usage of the product.

3.6 Tolerances: Unless otherwise specified, tolerances shall conform to the following:

3.6.1 Thickness, Width, Length, and Straightness: All applicable requirements of AMS 2242.

3.6.2 Flatness: Flatness tolerance for product 36 in. (900 mm) and under in width shall be 5% if nominal thickness is less than 0.025 in. (0.62 mm) and 3% if nominal thickness is 0.025 to 0.1875 in. (0.62 to 4.75 mm), exclusive. Flatness tolerance for product under 0.1875 in. (4.75 mm) in nominal thickness and over 36 in. (900 mm) wide shall be agreed upon by purchaser and vendor.

3.6.2.1 Flatness shall be determined from the expression $100 H/L$ where "H" is the distance from the straight edge to the product at the point of greatest separation and "L" is the distance between contact points of a straight edge laid in any direction on the product.

3.6.2.2 Flatness tolerances do not apply to coiled products.

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 the same 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 Tensile Property, Bending, Microstructure, and Surface Contamination Requirements: One sample from each lot.
- 4.3.2.1 Tensile specimens from widths 9 in. (225 mm) and over shall be taken with the axis of the specimen perpendicular to the direction of rolling; for widths less than 9 in. (225 mm), specimens shall be taken with the axis parallel to the direction of rolling.
- 4.3.2.2 For V-block or U-channel bend tests, specimen width shall be not less than 10 times the nominal thickness but not less than 1 in. (25 mm). For free bend tests, minimum specimen width shall, when possible, be not less than 10 times the nominal thickness; maximum width need not be greater than 1 in. (25 mm).
- 4.4 Reports:
- 4.4.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and for hydrogen content, tensile and bending properties, and surface contamination of each lot, and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, heat number, AMS 4908D, size, and quantity from each heat.