AEROSPACE MATERIAL SPECIFICATION

AMS4926	REV. N

Issued 1958-03
Revised 2015-07

Superseding AMS4926M

Titanium Alloy, Bars, Wire, and Rings
5Al - 2.5Sn
Annealed, 110 ksi (758 MPa) Yield Strength
(Composition similar to UNS R54520)

RATIONALE

AMS4926N results from a Five Year Review and update of this specification that includes the removal of sample size allowance for hydrogen of Table 1 (covered by ASTM E1447), requires agreement on mechanical property values for material outside specification ranges (3.5.1.1.4 and 8.6), the addition of AS6279 (3.8), adds AMS2368 (4.3 and 4.5) and revises the report paragraph (4.4).

1. SCOPE

1.1 Form

This specification covers a titanium alloy in the form of bars, wire, flash welded rings 4.000 inches (101.60 mm) and under in nominal diameter or least distance between parallel sides and 16 square inches (103 cm^2) and under in cross-sectional area, and stock of any size for flash welded rings.

1.2 Application

These products have been used typically for parts requiring strength up to 800 °F (427 °C) and which may be welded during fabrication, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2241 Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire

AMS2249 Chemical Check Analysis Limits, Titanium and Titanium Alloys

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AMS 2368 Sampling and Testing of Wrought Titanium Raw Material Except Forgings and Forging Stock

AMS 2750 Pyrometry

AMS 2809 Identification, Titanium and Titanium Alloy Wrought Products

AMS 7498 Rings, Flash Welded, Titanium and Titanium Alloys

AS6279 Production, Distribution, and Procurement of Metal Stock

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM E8/E8M Tension Testing of Metallic Materials

ASTM E1409 Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique

ASTM E1447 Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity/Infrared Detection Method

ASTM E1941 Determination of Carbon in Refractory and Reactive Metals and Their Alloys by Combustion Analysis

ASTM E2371 Analysis of Titanium and Titanium Alloys by Direct Current Plasma and Inductively Coupled Plasma Atomic Emission Spectrometry

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Table 1; carbon shall be determined in accordance with ASTM E1941, hydrogen in accordance with ASTM E1447, oxygen and nitrogen in accordance with ASTM E1409, and other elements in accordance with ASTM E2371. Other analytical methods may be used if acceptable to the purchaser.

Table 1 - Composition

Element	min	max	
Aluminum	4.00	6.00	
Tin	2.00	3.00	
Iron	--	0.50	
Oxygen	--	0.20	
Carbon	--	0.08	
Nitrogen	--	0.05	(500 ppm)
Hydrogen	--	0.020	(200 ppm)
Yttrium (3.1.1)	--	0.005	(50 ppm)
Other Elements, each (3.1.1)	--	0.10	
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 AMS2249.

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Alloy shall be multiple melted. The first melt shall be made by vacuum consumable electrode, nonconsumable electrode, electron beam cold hearth, or plasma arc cold hearth melting practice. The subsequent melt or melts shall be made under vacuum using vacuum arc remelting (VAR) practice. Alloy additions are not permitted in the final melt cycle.

3.2.1 The atmosphere for nonconsumable electrode melting shall be vacuum or shall be argon and/or helium at an absolute pressure not higher than 1000 mm of mercury.

3.2.2 The electrode tip for nonconsumable electrode melting shall be water-cooled copper.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Bars

Hot finished with or without subsequent cold reduction, annealed, and descaled. Bar shall be processed to the final thickness/diameter by metallurgical working operations prior to any straightening, dimensional sizing or surface finishing operations. Bar shall not be cut from plate.

3.3.2 Wire

Cold drawn, annealed, and descaled.

3.3.3 Flash Welded Rings

Fabricated in accordance with AMS7498, annealed, and descaled.

3.3.4 Stock for Flash Welded Rings

As ordered by the flash welded ring manufacturer.

3.4 Annealing

Bars, wire, and flash welded rings shall be annealed by heating to a temperature within the range 1325 to 1550 °F (718 to 843 °C), holding at the selected temperature within ±25 °F (±14 °C) for 10 minutes to 4 hours depending on section thickness, and cooling as required. Pyrometry shall be in accordance with AMS2750.

3.5 Properties

The product shall conform to the following requirements and shall also meet the requirements of 3.5.1.1, and 3.5.1.2 after being heated to any temperature up to 1250 °F (677 °C), held at heat for 20 minutes ±3, cooled in air, and descaled.

3.5.1 Bars, Wire, and Flash Welded Rings

Product 4.000 inches (101.60 mm) and under in nominal diameter or least distance between parallel sides and 16 square inches (103 cm^2) and under in cross-sectional area shall conform to the following requirements:

3.5.1.1 Tensile Properties

Shall be as specified in Table 2, determined in accordance with ASTM E8/E8M with the rate of strain set at 0.005 inch/inch/minute (0.005 mm/mm/minute) and maintained within a tolerance of ±0.002 inch/inch/minute (±0.002 mm/mm/minute) through the 0.2% offset yield strain.

Table 2A - Minimum tensile properties, inch/pound units

Nominal Diameter or Least Distance Between Parallel Sides Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D % Long.	Elongation in 2 Inches or 4D % L.T.	Elongation in 2 Inches or 4D % S.T.	Reduction of Area % Long.	Reduction of Area % L.T.	Reduction of Area % S.T.
Up to 2.000, incl	115	110	10	10	--	25	20	--
Over 2.000 to 4.000, incl	115	110	10	8	8	20	15	10

Table 2B - Minimum tensile properties, SI units

Nominal Diameter or Least Distance Between Parallel Sides Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D % Long.	Elongation in 50.8 mm or 4D % L.T.	Elongation in 50.8 mm or 4D % S.T.	Reduction of Area % Long.	Reduction of Area % L.T.	Reduction of Area % S.T.
Up to 50.80, incl	793	758	10	10	--	25	20	--
Over 50.80 to 101.60, incl	793	758	10	8	8	20	15	10

NOTE:
Long. = Longitudinal
L.T. = Long-Transverse
S.T. = Short-Transverse

3.5.1.1.1 Tensile and yield strength requirements apply in both longitudinal and transverse directions. Transverse tensile properties of Table 2 apply only to product that a test specimen not less than 2.50 inch (63.5 mm) in length can be obtained. Tests in the transverse direction are not required on product tested in the longitudinal direction

3.5.1.1.2 Longitudinal requirements in Table 2 apply to wire, to specimens from bars taken with the axis approximately parallel to the grain flow, and to specimens taken in the circumferential direction from flash welded rings.

3.5.1.1.3 Yield strength and reduction of area requirements do not apply to wire under 0.125 inch (3.18 mm) in diameter or least distance between parallel sides.

3.5.1.1.4 Mechanical property requirements for product outside the size range covered by Table 2 shall be agreed upon between purchaser and producer.

3.5.1.2 Microstructure shall be that resulting from processing within the alpha phase field and shall consist of equiaxed or elongated alpha.

3.5.1.3 Surface Contamination

The product shall be free of any oxygen-rich layer (See 8.3), such as alpha case, or other surface contamination, determined by microscopic examination at 400X magnification or by other method acceptable to purchaser.

3.5.1.3.1 When permitted by purchaser, flash welded rings to be machined all over may have an oxygen-rich layer provided such layer is removable within the machining allowance.

3.5.2 Stock for Flash Welded Rings

When a sample of stock is annealed as in 3.4, specimens taken from the stock shall conform to the requirements of 3.5.1.1

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3.7 Tolerances

Bars and wire shall conform to all applicable requirements of AMS2241.

3.8 Production, distribution, and procurement of metal stock shall comply with AS6279. This requirement becomes effective September 1, 2016.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer's test and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are acceptance tests and shall be performed on each heat or lot as applicable:

4.2.1.1 Composition (3.1) of each heat and hydrogen content of each lot.

4.2.1.2 Tensile properties (3.5.1.1), microstructure (3.5.1.2), and surface contamination (3.5.1.3) of each lot of bars, wire, and flash welded rings as received.

4.2.1.3 Tolerances (3.7) of each lot of bars and wire.

4.2.2 Periodic Tests

The following requirements are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

4.2.2.1 Tensile properties (3.5.1.1) after reheating at 1250 °F (677 °C) for bars, wire, and flash welded rings.

4.2.2.2 Ability of stock for flash welded rings to develop required properties (3.5.2).

4.3 Sampling and Testing

Shall be in accordance with AMS2368 and 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 For Acceptance Tests

4.3.1.1 Composition

One sample from each heat; for hydrogen determination, one sample from each lot obtained after thermal and chemical processing is completed.

4.3.1.2 Tensile Properties

One or more samples from bars, wire, and flash welded rings from each lot.

4.3.1.2.1 Specimens from flash welded rings shall be cut from parent metal not including the weld-heat-affected zone.

4.3.1.3 Microstructure and Surface Contamination

One sample from each lot

4.3.2 For Periodic Tests

As agreed upon by purchaser and producer.

4.4 Reports

4.4.1 The producer shall furnish with each shipment a report showing producer identity, country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the results of tests for composition of each heat and for the hydrogen content, tensile properties, microstructure, and surface contamination of each lot, and state that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot number, AMS4926N, product form and size (and/or part number, if applicable), specific annealing treatment used, and quantity. The producer of stock for flash welded rings shall furnish with each shipment a report showing producer identity, country where the metal was melted (i.e., final melt in the case of metal processed by multiple melting operations) and the results of tests for composition of each heat and for the hydrogen content of each lot.

4.4.2 Report the nominal metallurgically worked cross sectional size and the cut size, if different (See 3.3.1).

4.4.3 When the bar, wire, or flash welded ring size is outside the range covered by 1.1, the report shall contain a statement to that effect.

4.5 Resampling and Retesting

In accordance with AMS2368.

5. PREPARATION FOR DELIVERY

5.1 Identification

5.1.1 Bars and Wire

In accordance with AMS2809.

5.1.2 Flash Welded Rings and Stock for Flash Welded Rings

As agreed upon by purchaser and producer.

5.2 Packaging

The product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery.

6. ACKNOWLEDGMENT

A producer shall include this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS

8. NOTES

8.1 A change bar (l) located in the left margin is for the convenience of the user in locating areas where technical revisions, not editorial changes, have been made to the previous issue of this document. An (R) symbol to the left of the document title indicates a complete revision of the document, including technical revisions. Change bars and (R) are not used in original publications, nor in documents that contain editorial changes only.

8.2 "A" values given in MMPDS are higher than specification values.

8.3 An oxygen-rich layer, such as alpha case, is hard and brittle and results in marked lowering of fatigue properties.

8.4 Terms used in AMS are clarified in ARP1917.

8.5 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.6 Purchase documents should specify not less than the following:

AMS4926N
Product form and size (and/or part number, if applicable) of product desired
Quantity of product desired
Property and acceptance requirements from the cognizant engineering organization applicable to sizes outside the size ranges listed in 1.1.

8.7 Similar Specifications

AMS-T-9047, 5Al-2.5Sn and MIL-T-9047, 5Al-2.5Sn

PREPARED BY AMS COMMITTEE "G"