SAE Aerospace
An SAE International Group

AEROSPACE MATERIAL SPECIFICATION

SAE AMS4914 REV. E

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Superseding AMS4914D

Titanium Alloy Cold Rolled Sheet and Strip
15V - 3Al - 3Cr - 3Sn
Solution Heat Treated

(Composition similar to UNS R58153)

RATIONALE

AMS4914E is a correction of the format of Table 1 (See 8.1.1). AMS4914D resulted from a Five Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a titanium alloy in the form of sheet and strip up to and including 0.125 inches in thickness.

1.2 Application

These products have been used typically in applications requiring high strength-to-weight ratio and stability up to 550 °F (288 °C), but usage is not limited to such applications. Parts are typically formed in the solution heat treated condition and subsequently precipitation heat treated to final condition.

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 724-776-4970 (outside USA), www.sae.org.

AMS2242	Tolerances, Corrosion and Heat-Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
AMS2249	Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS2750	Pyrometry
AMS2801	Heat Treatment of Titanium Alloy Parts
AMS2809	Identification, Titanium and Titanium Alloy Wrought Products

TO PLACE A DOCUMENT ORDER: Tel: 877-606-7323 (inside USA and Canada)
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: http://www.sae.org

SAE values your input. To provide feedback on this Technical Report, please visit
http://www.sae.org/technical/standards/AMS4914E

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 E 8 / E 8M	Tension Testing of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 290	Bend Testing of Material for Ductility
ASTM E 1409	Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique
ASTM E 1447	Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity/Infrared Detection Method
ASTM E 1941	Determination of Carbon in Refractory and Reactive Metals and Their Alloys
ASTM E 2371	Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma 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 E 1941, hydrogen in accordance with ASTM E 1447, oxygen and nitrogen in accordance with ASTM E 1409, and other elements in accordance with ASTM E 2371. Other analytical methods may be used if acceptable to the purchaser.

TABLE 1 - COMPOSITION

Element	min	max	
Vanadium	14.0	16.0	
Chromium	2.5	3.5	
Tin	2.5	3.5	
Aluminum	2.5	3.5	
Iron	--	0.25	
Oxygen	--	0.13	
Carbon	--	0.05	
Nitrogen	--	0.05	(500 ppm)
Hydrogen	--	0.015	(150 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 applicable requirements of AMS2249.

3.1.3 Sample size when using ASTM E 1447 for hydrogen may be as large as 0.35 gram.

3.2 Melting Practice

3.2.1 Alloy shall be multiple melted. Melting cycle(s) prior to the final melting cycle shall be made using vacuum consumable electrode, nonconsumable electrode, electron beam cold hearth, or plasma arc cold hearth melting practice(s). The final melting cycle shall be made under vacuum using vacuum arc remelting (VAR) practice with no alloy additions permitted.

3.2.1.1 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.

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

3.3 Condition

Hot rolled with subsequent cold reduction, solution heat treated, descaled, and leveled, having a surface appearance comparable to a commercial corrosion-resistant steel ASTM No. 2D finish (See 8.2).

3.4 Heat Treatment

Product shall be solution heat treated by heating to a temperature within the range 1450 to 1500 °F (788 to 816 °C), holding at the selected temperature within ±25 °F (±14 °C) for 3 to 30 minutes, and cooling at a rate that will produce product meeting the requirements of 3.5 (See 8.3). Pyrometry shall be in accordance with AMS2750.

3.5 Properties

The product shall conform to the following requirements:

3.5.1 As Solution Heat Treated

3.5.1.1 Tensile Properties

Shall be as shown in Table 2 for product 0.125 inch (3.18 mm) and under in nominal thickness, determined in accordance with ASTM E 8 / E 8M 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 2 - TENSILE PROPERTIES

Property	Value
Tensile Strength	102 to 137 ksi (703 to 945 MPa)
Yield Strength at 0.2% Offset	100 to 126 ksi (689 to 869 MPa)
Elongation in 2 Inches (50.8 mm)	12% minimum

3.5.1.2 Bending

Product 0.125 inch (3.18 mm) and under in nominal thickness, shall have a test sample prepared nominally 0.750 inch (19.06 mm) in width, with its axis of bending parallel to the direction of rolling. The sample shall be bend tested in accordance with the guided bend test defined in ASTM E 290 through an angle of 105 degrees. The test fixture supports shall have a contact radius 0.010 inch (0.25 mm) minimum, and the plunger shall have a radius equal to the bend factor shown in Table 3 times the nominal thickness. Examination of the bent sample shall not show evidence of cracking when examined at 15 to 25X magnification.

TABLE 3 - Bending

Nominal Thickness Inch	Nominal Thickness Millimeters	Bend Factor
Up to 0.070, incl	Up to 1.78, incl	4
Over 0.070 to 0.125, incl	Over 1.78 to 3.18, incl	5

3.5.1.3 Surface Contamination

The product shall be free of any oxygen-rich layer, such as alpha case, or other surface contamination, determined by the bend test of 3.5.1.2 or other method acceptable to purchaser.

3.5.2 After Precipitation Heat Treatment (Capability Test)

Precipitation heat treat in accordance with AMS2801 using the parameters of Tables 4 and 5.

3.5.2.1 Tensile Properties

Shall be as shown in Tables 4 and 5 for product 0.125 inch (0.32 mm) and under in nominal thickness, determined in accordance with ASTM E 8 / E 8M 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. Properties shall be verified for each precipitation heat treatment condition (See Tables 4 and 5).

TABLE 4 - MINIMUM TENSILE PROPERTIES AFTER PRECIPITATION HEAT TREATMENT OF HEATING TO 950 °F ± 10 (510 °C ± 6), HOLDING AT HEAT FOR 8 HOURS ± 0.5, AND COOLING IN AIR OR FASTER

Property	Value
Tensile Strength	145 ksi (1000 MPa)
Yield Strength at 0.2% Offset	140 ksi (965 MPa)
Elongation in 2 Inches (50.8 mm)	7%

TABLE 5 - MINIMUM TENSILE PROPERTIES AFTER PRECIPITATION HEAT TREATMENT OF HEATING TO 900 °F ± 10 (482 °C ± 6), HOLDING AT HEAT FOR 16 HOURS ± 0.5, AND COOLING IN AIR

Property	Value
Tensile Strength	180 ksi (1241 MPa)
Yield Strength at 0.2% Offset	170 ksi (1172 MPa)
Elongation in 2 Inches (50.8 mm)	5%

3.5.2.2 Average Grain Size

Shall be ASTM No. 6 or finer, determined by comparison of a polished and etched specimen with the chart in ASTM E 112.

3.6 Quality

The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from “oil cans” (See 8.4) of depth in excess of the flatness tolerances, ripples, and foreign materials and from imperfections detrimental to usage of the product.

3.7 Tolerances

Shall conform to all applicable requirements of AMS2242.

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 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

All technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing

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 and in the same heat treatment batch.

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.