



<b>AEROSPACE MATERIAL SPECIFICATION</b>	<b>AMS4911™</b>	<b>REV. R</b>
	Issued 1957-07 Revised 2019-12 Superseding AMS4911P	
Titanium Alloy, Sheet, Strip, and Plate 6Al - 4V Annealed (Composition similar to UNS R56400)		

## RATIONALE

AMS4911R adds skull melting as a first melt in remelted applications (3.2 and 4.4.1) and exception notice (3.9).

### 1. SCOPE

#### 1.1 Form

This specification covers a titanium alloy in the form of sheet, strip, and plate up through 4.000 inches (101.60 mm) inclusive in thickness.

#### 1.2 Application

These products have been used typically for parts requiring strength up to 750 °F (399 °C), but usage is not limited to such applications.

1.2.1 Certain processing procedures and service conditions may cause these products to become subject to stress-corrosion cracking; ARP982 recommends practices to minimize such conditions.

### 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](http://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

AMS2368 Sampling and Testing of Wrought Titanium Raw Material Except Forgings and Forging Stock

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AMS2631	Ultrasonic Inspection Titanium and Titanium Alloy Bar, Billet and Plate
AMS2750	Pyrometry
AMS2809	Identification, Titanium and Titanium Alloy Wrought Products
ARP982	Minimizing Stress-Corrosion Cracking in Wrought Titanium Alloy Products
ARP1917	Clarification of Terms Used in Aerospace Metals Specifications
AS1814	Terminology for Titanium Microstructures
AS4194	Sheet and Strip Surface Finish Nomenclature
AS6279	Standard Practice for 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](http://www.astm.org).

ASTM A480/A480M	General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM E8/E8M	Tension Testing of Metallic Materials
ASTM E290	Bend Testing Material for Ductility
ASTM E384	Microindentation Hardness of Materials
ASTM E539	Analysis of Titanium Alloys by X-Ray Fluorescence Spectrometry
ASTM E1409	Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by Inert Gas Fusion
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
ASTM E2994	Analysis of Titanium and Titanium Alloys by Spark Atomic Emission Spectrometry and Glow Discharge 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 E539, ASTM E2371, or ASTM E2994. Other analytical methods may be used if acceptable to the purchaser.

**Table 1 - Composition**

Element	Min	Max
Aluminum	5.50	6.75
Vanadium	3.50	4.50
Iron	--	0.30
Oxygen	--	0.20
Carbon	--	0.08
Nitrogen	--	0.05 (500 ppm)
Hydrogen	--	0.015 (150 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 applicable requirements of AMS2249.

### 3.2 Melting Practice

Alloy shall be multiple melted. The first melt shall be made by vacuum consumable electrode, nonconsumable electrode, electron beam cold hearth, plasma arc cold hearth or skull melting practice. The subsequent melt or melts shall be made 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 Sheet and Strip

Hot rolled with or without subsequent cold reduction, annealed, descaled, and leveled, having a surface appearance comparable to a commercial corrosion-resistant steel sheet No. 2D finish (see 8.2).

#### 3.3.2 Plate

Hot rolled, annealed, descaled, and flattened, having a surface appearance comparable to a commercial corrosion-resistant steel No. 1 finish (see 8.2). Plate product shall be produced using standard industry practices for the production of plate to the procured thickness. Bar, billet, forgings, or forging stock shall not be substituted for plate.

### 3.4 Annealing

The product shall be annealed by heating to a temperature within the range 1300 to 1650 °F (704 to 899 °C), holding at the selected temperature within  $\pm 25$  °F ( $\pm 14$  °C) for a time commensurate with product thickness and the heating equipment and procedure used, and cooling at a rate which will produce product meeting the requirements of 3.5. Pyrometry shall be in accordance with AMS2750.

### 3.5 Properties

The product shall conform to the following requirements and also shall meet the requirements of 3.5.1 and 3.5.2 after being reheated in air to 1325 °F  $\pm$  15 °F (718 °C  $\pm$  8 °C), held at heat for 20 minutes  $\pm$  2 minutes, cooled at a rate equivalent to an air cool or slower.