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## **Standard Specification for Wrought Titanium-6Aluminum-4Vanadium Alloy for Surgical Implant Applications (UNS R56400)<sup>1</sup>**

This standard is issued under the fixed designation F 1472; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### **1. Scope\***

1.1 This specification covers the chemical, mechanical, and metallurgical requirements for wrought annealed titanium-6aluminum-4vanadium alloy (UNS R56400) to be used in the manufacture of surgical implants.

~~1.2 The values stated in inch-pound units are to be regarded as the standard. The SI equivalents in parentheses are provided for information only.~~

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

### **2. Referenced Documents**

#### *2.1 ASTM Standards:<sup>2</sup>*

E 8 Test Methods ~~for~~ Tension Testing of Metallic Materials

~~E 120 Test Methods for Chemical Analysis of Titanium and Titanium Alloys~~ 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 290 Test Methods for Bend Testing of Materials ~~Material~~ for Ductility

E 527 ~~Practice for Numbering Metals and Alloys (UNS)~~ Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)

E 1409 Test Method for Determination of Oxygen and Nitrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Technique

E 1447 ~~Test Method for Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity Method~~

~~F 981 Practice for Assessment of Compatibility of Biomaterials for Surgical Implants with Respect to Effect of Materials on Muscle and Bone~~ Test Method for Determination of Hydrogen in Titanium and Titanium Alloys by the Inert Gas Fusion Thermal Conductivity/Infrared Detection Method

E 2371 Test Method for Analysis of Titanium and Titanium Alloys by Atomic Emission Plasma Spectrometry

#### *2.2 ASQ Standard:<sup>3</sup>*

ASQ C1 Specifications of General Requirements for a Quality Program

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee F04 on Medical and Surgical Materials and Devices and is the direct responsibility of Subcommittee F04.12 on Metallurgical Materials.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards*, Vol 03.01, volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.05.

<sup>3</sup> Available from American Society for Quality (ASQ), 600 N. Plankinton Ave., Milwaukee, WI 53203, <http://www.asq.org>.

**\*A Summary of Changes section appears at the end of this standard.**

### 2.3 Aerospace Material Specifications:<sup>4</sup>

AMS 2249 Chemical Check Analysis Limits, Titanium and Titanium Alloys

AMS 4911 Titanium Alloy Sheet, Strip, and Plate 6Al-4V Annealed

AMS 4928 Titanium Alloy Bars, Wire, Forgings, Rings, and Drawn Shapes 6Al-4V Annealed

AMS 4965 Titanium Alloy, Bars, Wire, Forgings, and Rings 6.0Al-4.0V Solution Heat Treated and Aged

### 2.4 Society of Automotive Engineers Standard—ISO Standards:<sup>5</sup>

ISO 5823-3 Implants for Surgery—Metallic Materials—Part 3, Wrought Titanium-6Aluminum-4Vanadium Alloy

ISO 9001 Quality Management Systems—Requirements

### 2.5 Society of Automotive Engineers Standard:<sup>4, 6</sup>

SAE J1086 Practice for Numbering Metals and Alloys (UNS)

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.2 *lot, n*—the total number of mill products produced from one heat under the same conditions at essentially the same time.

## 4. Product Classification

4.1 *Strip*—Any product under 0.1875/0.188 in. (4.75/4.76 mm) in thickness and under 24 in. (610 mm) wide.

4.2 *Sheet*—Any product under 0.1875/0.188 in. (4.75/4.76 mm) in thickness and 24 in. (610 mm) or more in width.

4.3 *Plate*—Any product 0.1875/0.188 in. (4.75/4.76 mm) thick and over and 10 in. (254 mm) wide and over, with widths greater than five times thickness. Plate up to 4.00 in. (101.60/102 mm) thick, inclusive, is covered by this specification.

4.4 *Bar*—Round bars and flats from 0.1875/0.188 in. (4.75/4.76 mm) to 4.00 in. (101.60/102 mm) in diameter or thickness (other sizes and shapes by special order).

4.5 *Forging Bar*—Bar as described in 4.4, ~~used for production of forgings, may be furnished in the hot rolled condition, used in the production of forgings.~~ This product may be furnished in the hot worked condition.

4.6 *Wire*—~~Rounds or flats less than 0.1875 in. (4.75 mm) in diameter.~~ Rounds, flats, or other shapes less than 0.188 in. (4.76 mm) in diameter or thickness.

## 5. Ordering Information

5.1 Include with inquiries and orders for material under this specification the following information:

5.1.1 Quantity,

5.1.2 ASTM designation and date of issue,

5.1.3 Form (sheet, strip, plate, bar, or wire),

5.1.3 Form (strip, sheet, plate, bar, forging bar, or wire),

5.1.4 Condition (see 6.3),

5.1.5 Mechanical properties (if applicable, for special conditions),

5.1.6 Finish (see 6.2),

5.1.7 Applicable dimensions including size, thickness, width, length, or drawing number,

5.1.8 Special tests, if any, and

5.1.9 Other requirements.

## 6. Materials and Manufacture

6.1 The various titanium mill products covered in this specification normally are formed with the conventional forging and rolling equipment found in primary ferrous and nonferrous plants. The alloy is usually multiple melted in arc furnaces (including furnaces such as plasma arc and electron beam) of a type conventionally used for reactive metals.

6.2 *Finish*—~~The mill product may be furnished to the purchaser as mechanically descaled or pickled, sandblasted, chemically milled, ground, machined, peeled, polished, combinations of these operations, or as specified by the purchaser.~~ The mill product may be furnished to the purchaser as mechanically descaled or pickled, sandblasted, chemically milled, ground, machined, peeled, polished, combinations of these operations, or as specified by the purchaser. On billets, bars, plates, and forgings, it is permissible to remove minor surface imperfections by grinding if the resultant area meets the dimensional and surface finish requirements of this specification.

6.3 *Condition*—Material shall be furnished in the annealed or cold-worked condition.

<sup>4</sup>Annual Book of ASTM Standards, Vol 01.01.

<sup>4</sup>Available from Society of Automotive Engineers (SAE), 400 Commonwealth Dr., Warrendale, PA 15096-0001, <http://www.sae.org>.

<sup>5</sup>Annual Book of ASTM Standards, Vol 03.06.

<sup>5</sup>Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

<sup>6</sup>Annual Book of ASTM Standards, Vol 13.01.

<sup>6</sup>New designation established in accordance with E 527 and SAE J1086.