

**Titanium Alloy Wire  
44.5 Cb**

(Composition similar to UNS R58450)

**1. SCOPE:**

**1.1 Form:**

The specification covers a titanium alloy in the form of wire.

**1.2 Application:**

This wire has been used typically for parts, such as fasteners, where cold formability is desirable or necessary and which requires a high strength-to-weight ratio up to 800 °F (427 °C), but usage is not restricted to such applications.

**1.3 Classification:**

This specification covers two types of wire based upon condition supplied, as follows:

- a. Type 1: Annealed
- b. Type 2: As drawn

**1.3.1 Type 1 shall be supplied unless Type 2 is specified.**

**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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

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## 2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or [www.sae.org](http://www.sae.org).

AMS 2241	Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2241	Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
AMS 2249	Chemical Check Analysis Limits, Titanium and Titanium Alloys
AMS 2809	Identification, Titanium and Titanium Alloy Wrought Products

## 2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or [www.astm.org](http://www.astm.org).

ASTM E 8	Tension Testing of Metallic Materials
ASTM E 8M	Tension Testing of Metallic Materials (Metric)
ASTM E 112	Determining Average Grain Size
ASTM E 120	Chemical Analysis of Titanium and Titanium Alloys
ASTM E 1409	Determination of Oxygen 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 Method

## 3. TECHNICAL REQUIREMENTS:

### 3.1 Composition:

Shall conform to the percentages by weight shown in Table 1; oxygen shall be determined in accordance with ASTM E 1409, hydrogen in accordance with ASTM E 1447, and other elements in accordance with ASTM E 120, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	Min	Max
Columbium	42.00	47.00
Oxygen	--	0.16
Carbon	--	0.04
Silicon	--	0.03
Nitrogen	--	0.03 (300 ppm)
Iron	--	0.03
Chromium	--	0.02
Magnesium	--	0.01
Manganese	--	0.01
Hydrogen	--	0.0035 (35 ppm)
Residual Elements, total (3.1.1)	--	0.40
Titanium	remainder	

3.1.1 Determination not required for routine acceptance.

3.1.2 When ASTM E 1447 is used, sample size may be as large as 0.35 gram.

3.1.3 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2249. Check analysis limits for columbium fall within the limits of Table 1.

3.2 Melting Practice:

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

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:

3.3.1 Type 1 Wire: Cold finished and annealed.

3.3.2 Type 2 Wire: Cold finished, with drawing lubricant removed, unless otherwise specified by purchaser.

### 3.4 Heat Treatment:

Type 1 wire shall be annealed by heating in vacuum (less than 0.1  $\mu\text{m}$  mercury) to a temperature within the range 1450 to 1600 °F (788 to 871 °C), holding at heat for sufficient time to produce a recrystallized structure which will meet the requirements of 3.5, and cooling as required.

### 3.5 Properties:

Wire shall conform to the following requirements:

#### 3.5.1 Type 1 Annealed Wire:

- 3.5.1.1 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M as applicable, with the rate of strain maintained at 0.003 to 0.007 inch/inch per minute (0.003 to 0.007 mm/mm per minute) 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 inch/inch per minute (0.005 mm/mm per minute) through the yield strength and a minimum cross-head speed of 0.10 inch per minute (0.04 mm/s) above the yield strength.

TABLE 2 - Minimum Tensile Properties

Properties	Value
Tensile Strength	65.0 ksi (448 MPa)
Yield Strength at 0.2% Offset	60.0 ksi (414 MPa)
Elongation in 2 Inches (50.8 mm) or 4D	10%
Reduction of Area	50%

- 3.5.1.1.1 Yield strength and reduction of area requirements do not apply to wire under 0.125 inch (3.18 mm) in diameter.

- 3.5.1.2 Grain Size: Shall be ASTM No. 5 or finer with occasional fields as large as ASTM No. 4 permitted, determined by comparison of a polished and etched sample with the chart in ASTM E 112.

- 3.5.2 Type 2 As-Drawn Wire: Shall be as agreed upon by purchaser and vendor except that Type 2 wire annealed as in 3.4 shall also meet the requirements of 3.5.1.1 and 3.5.1.2.

### 3.6 Quality:

Wire, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the wire.

### 3.7 Tolerances:

Shall conform to all applicable requirements of AMS 2241 or MAM 2241.

## 4. QUALITY ASSURANCE PROVISIONS:

### 4.1 Responsibility for Inspection:

The vendor of wire 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 wire conforms to the specified requirements.

### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests for the following requirements are acceptance tests and shall be performed on each heat or lot as applicable:

#### 4.2.1.1 Type 1:

4.2.1.1.1 Composition (3.1) of each heat.

4.2.1.1.2 Hydrogen content (3.1), tensile properties (3.5.1), grain size (3.5.2) and tolerances (3.7) of each lot.

#### 4.2.1.2 Type 2:

4.2.1.2.1 Composition (3.1) of each heat.

4.2.1.2.2 Tolerances (3.7) of each lot.

4.2.2 Periodic Tests: Tests of Type 2 wire to demonstrate ability to develop required properties (3.5.2) are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

### 4.3 Sampling and Testing:

Shall be in accordance with the following; a lot shall be all wire of the same nominal size from the same heat processed at the same time:

#### 4.3.1 For Acceptance Tests:

##### 4.3.1.1 Type 1:

4.3.1.1.1 Composition: One or more samples from each heat, except that for hydrogen determinations one sample from each lot obtained after thermal and chemical processing is completed.