



Designation: **B863-08a** Designation: **B 863 - 09**

Standard Specification for Titanium and Titanium Alloy Wire¹

This standard is issued under the fixed designation B 863; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope*

1.1 This specification covers titanium and titanium alloy wire as follows:

- 1.1.1 *Grade 1*—Unalloyed titanium, low oxygen,
- 1.1.2 *Grade 2*—Unalloyed titanium, standard oxygen,
 - 1.1.2.1 *Grade 2H*—Unalloyed titanium (Grade 2 with 58 ksi minimum UTS),
- 1.1.3 *Grade 3*—Unalloyed titanium, medium oxygen,
- 1.1.4 *Grade 4*—Unalloyed titanium, high oxygen,
- 1.1.5 *Grade 5*—Titanium alloy (6 % aluminum, 4 % vanadium),
- 1.1.6 *Grade 6*—Titanium alloy (5 % aluminum, 2.5 % tin),
- 1.1.7 *Grade 7*—Unalloyed titanium plus 0.12 to 0.25 % palladium, standard oxygen,
 - 1.1.7.1 *Grade 7H*—Unalloyed titanium plus 0.12 to 0.25 % palladium (Grade 7 with 58 ksi minimum UTS),
- 1.1.8 *Grade 9*—Titanium alloy (3 % aluminum, 2.5 % vanadium),
- 1.1.9 *Grade 11*—Unalloyed titanium plus 0.12 to 0.25 % palladium, low oxygen,
- 1.1.10 *Grade 12*—Titanium alloy (0.3 % molybdenum, 0.8 % nickel),
- 1.1.11 *Grade 13*—Titanium alloy (0.5 % nickel, 0.05 % ruthenium),
- 1.1.12 *Grade 14*—Titanium alloy (0.5 % nickel, 0.05 % ruthenium),
- 1.1.13 *Grade 15*—Titanium alloy (0.5 % nickel, 0.05 % ruthenium),
- 1.1.14 *Grade 16*—Unalloyed titanium plus 0.04 to 0.08 % palladium, standard oxygen,
 - 1.1.14.1 *Grade 16H*—Unalloyed titanium plus 0.04 to 0.08 % palladium (Grade 16 with 58 ksi minimum UTS),
- 1.1.15 *Grade 17*—Unalloyed titanium plus 0.04 to 0.08 % palladium, low oxygen,
- 1.1.16 *Grade 18*—Titanium alloy (3 % aluminum, 2.5 % vanadium) plus 0.04 to 0.08 % palladium,
- 1.1.17 *Grade 19*—Titanium alloy (3 % aluminum, 8 % vanadium, 6 % chromium, 4 % zirconium, 4 % molybdenum),
- 1.1.18 *Grade 20*—Titanium alloy (3 % aluminum, 8 % vanadium, 6 % chromium, 4 % zirconium, 4 % molybdenum) plus 0.04 to 0.08 % palladium,
- 1.1.19 *Grade 21*—Titanium alloy (15 % molybdenum, 3 % aluminum, 2.7 % niobium, 0.25 % silicon),
- 1.1.20 *Grade 23*—Titanium alloy (6 % aluminum, 4 % vanadium with extra low interstitial elements, ELI),
- 1.1.21 *Grade 24*—Titanium alloy (6 % aluminum, 4 % vanadium) plus 0.04 % to 0.08 % palladium,
- 1.1.22 *Grade 25*—Titanium alloy (6 % aluminum, 4 % vanadium) plus 0.3 to 0.8 % nickel and 0.04 to 0.08 % palladium,
- 1.1.23 *Grade 26*—Unalloyed titanium plus 0.08 to 0.14 % ruthenium,
 - 1.1.23.1 *Grade 26H*—Unalloyed titanium plus 0.08 to 0.14 % ruthenium (Grade 26 with 58 ksi minimum UTS),
- 1.1.24 *Grade 27*—Unalloyed titanium plus 0.08 to 0.14 % ruthenium,
- 1.1.25 *Grade 28*—Titanium alloy (3 % aluminum, 2.5 % vanadium) plus 0.08 to 0.14 % ruthenium,
- 1.1.26 *Grade 29*—Titanium alloy (6 % aluminum, 4 % vanadium with extra low interstitial elements, ELI) plus 0.08 to 0.14 % ruthenium,
- 1.1.27 *Grade 32*—Titanium alloy (5 % aluminum, 1 % tin, 1 % vanadium, 1 % zirconium, 0.8 % molybdenum),
- 1.1.28 *Grade 33*—Titanium alloy (0.4 % nickel, 0.015 % palladium, 0.025 % ruthenium, 0.15 % chromium),
- 1.1.29 *Grade 34*—Titanium alloy (0.4 % nickel, 0.015 % palladium, 0.025 % ruthenium, 0.15 % chromium),
- 1.1.30 *Grade 35*—Titanium alloy (4.5 % aluminum, 2 % molybdenum, 1.6 % vanadium, 0.5 % iron, 0.3 % silicon),
- 1.1.31 *Grade 36*—Titanium alloy (45 % niobium),
- 1.1.32 *Grade 37*—Titanium alloy (1.5 % aluminum), and
- 1.1.33 *Grade 38*—Titanium alloy (4 % aluminum, 2.5 % vanadium, 1.5 % iron).

NOTE 1—H grade material is identical to the corresponding numeric grade (that is, Grade 2H = Grade 2) except for the higher guaranteed minimum

¹ This specification is under the jurisdiction of ASTM Committee B10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.01 on Titanium.

Current edition approved Aug. 1, 2008; 2009. Published August 2008; June 2009. Originally approved in 1995. Last previous edition approved in 2008 as B 863 - 08a.

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

UTS, and may always be certified as meeting the requirements of its corresponding numeric grade. Grades 2H, 7H, 16H, and 26H are intended primarily for pressure vessel use.

The H grades were added in response to a user association request based on its study of over 5200 commercial Grade 2, 7, 16, and 26 test reports, where over 99 % met the 58 minimum UTS.

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:²

E 8 Test Methods for Tension Testing of Metallic Materials

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

E 539 Test Method for X-Ray Fluorescence Spectrometric Analysis of 6Al-4V Titanium Alloy

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 Inert Gas Fusion Thermal Conductivity/Infrared Detection Method

E 1941 Test Method for Determination of Carbon in Refractory and Reactive Metals and Their Alloys

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

E 2626 Guide for Spectrometric Analysis of Reactive and Refractory Metals

2.2 AWS Standard:³

AWS A5.16/A5.16M-2007 Specification for Titanium and Titanium Alloy Welding Electrodes and Rods

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *coils, n*—wire in coil form with pitch and cast as described by purchaser.

3.1.2 *straight lengths, n*—wire in straight lengths, generally made by straightening wire from coils by the producer.

3.1.3 *weld wire, n*—round wire for welding.

3.1.4 *wire, n*—rounds, flats, or special shapes from 0.020 in. (0.5 mm) to 0.250 in. (6.4 mm) in thickness or major dimension.

4. Product Classification

4.1 *Wire*—See 3.1.4.

4.2 *Coils*—Coiled wire may be spooled on spools if required by the user.

4.3 *Straight Lengths*—After straightening, it may be necessary to perform cleaning or other finishing operations. Straight lengths are normally 10 to 12 ft long (random). Exact lengths may be specified by the purchaser when necessary.

4.4 *Filler Metal or Weld Wire*—Wire for welding filler metal application has special requirements for more restrictive chemistry that allows for oxygen increase inherent in most welding processes used for titanium, and has tighter limits on iron, carbon, nitrogen, and hydrogen. AWS ER Ti-XX grades are specifically designed for welding the corresponding ASTM XX wrought or cast material grades. In addition, special requirements for spooling, such as layer winding, cast, and helix, packaging to maintain cleanliness, and identification are necessary. Use AWS A5.16/A5.16M-2007 for wire for titanium and titanium alloy filler metal.

5. Ordering Information

5.1 . Orders for material under this specification shall include the following information as applicable:

5.1.1 Grade number (Section 1),

5.1.2 Product description (Sections 3 and 4),

5.1.3 Chemistry (Table 1),

5.1.4 Mechanical properties (if applicable, Table 2),

5.1.5 Marking and packaging (Section 17),

5.1.6 Finish (Section 9),

5.1.7 Applicable dimensions including size, thickness, width, spool size, coil diameter, and length (exact, random, multiples) or print number,

5.1.8 Required reports (Section 16),

5.1.9 Special tests or requirements, and

5.1.10 Disposition of rejected material (Section 15).

6. Chemical Composition

6.1 The grades of titanium and titanium alloy metal covered by this specification shall conform to the requirements as to chemical composition prescribed in Table 1.

² For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

³ Available from American Welding Society (AWS), 550 NW LeJeune Rd., Miami, FL 33126, <http://www.aws.org>.

Element	Composition, %	
	Weight Percent	Weight Percent
Aluminum	0.1	0.1
Barium	0.006	0.006
Bismuth	0.4	0.4
Boron	0.1	0.1
Calcium	0.1	0.1
Carbon	0.1	0.1
Chromium	12.0-14.0	12.0-14.0
Copper	0.1	0.1
Fluorine	0.001	0.001
Iron	0.001	0.001
Magnesium	0.001	0.001
Manganese	0.001	0.001
Molybdenum	0.02-0.05	0.02-0.05
Nickel	0.1	0.1
Niobium	0.01	0.01
Nitrogen	0.001	0.001
Oxygen	0.001	0.001
Phosphorus	0.001	0.001
Rhenium	0.01	0.01
Rhodium	0.001	0.001
Ruthenium	0.001	0.001
Silicon	0.1	0.1
Sulfur	0.001	0.001
Tantalum	0.001	0.001
Tin	0.001	0.001
Tungsten	0.001	0.001
Zirconium	0.001	0.001

iTech Standards
<https://standards.itih.ai>
 Document Preview

ASTM B863-09

<https://standards.itih.ai/catalog/standards/sist/58f6a399-7344-4d61-bf06-ae977b9362b1/astm-b863-09>

Element	Composition, %										
	Grade 14-	Grade 14- 150.04- 0.06	Grade 14- 40.4-0.6	Grade 16H -	Grade 17-	Grade 18-	Grade 19-	Grade 20-	Grade 21-	Grade 23-	Grade 25
Palladium -	..	..	..	..	..	..	0.1	0.4	..	..	Grade 25 240.1
19	0.05	0.12	0.03	0.04- 0.08	..	..	3.5-4.5	5.5-6.5	..	3.5-4.5	..
Cobalt	0.30	3.0-4.0	7.5-8.5	..	3.5- 4.5	14.0- 16.0	..	..	..	..	..
Molybdenum -	..	0.15	0.4	..	4.5	3.0-4.0	7.5-8.5	0.04-0.08	..	..	..
20	0.05	0.12	0.03	0.02	0.30	..	5.5- 6.5	5.5- 6.5	..	..4	..
Chromium	..	..	..	..	..	..	..	..	..	..	..
Chromium -	..	3.5-4.5	5.5-6.5	..	3.5-4.5	..	..	..	0.15	0.4	..
21	0.05	0.15	0.03	..	..	..	..	..	..	..	0.3- 0.8
Nickel	0.6	0.6	0.40	..	..	..	..	..	..	..	0.3- 0.8
Nickel 17	0.03	0.015	0.40	2.5-3.5	..	..	..	..	14.0-16.0	..	0.3- 0.8
Niobium	2.2-3.2	..	0.15-0.25	..	0.4	..	..	..	..	..	..
Niobium -	..	..	..	0.1	0.25	5.5-6.5	3.5-4.5	3.5- 4.5	..	..	..
23	0.08	0.13	0.03	0.0125	0.25	..	..	..	..	..	..
Zirconium	..	..	..	..	..	..	..	..	..	..	..
Zirconium 5	..	..	..	..	..	..	..	..	..	..	0.4
Silicon	..	..	..	..	..	..	..	..	0.15- 0.25	..	..
24	0.08	0.20	0.05	0.015	0.40	5.5-6.75	3.5-4.5	0.04-0.08	..	..	..
Residuals, D, E, F	0.1	0.1	0.1	0.1	0.1	0.1	0.14	..	..	..	..
max each	..	..	..	..	..	..	..	..	..	..	..
Residuals, D, E, F	..	..	..	..	..	..	..	..	..	..	..
max each -	..	..	..	..	..	..	..	..	..	..	..
25	0.15	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
25	0.08	0.20	0.05	0.015	0.4	..	..	..	..	..	..
Residuals, D, E, F	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4
max total	..	..	..	..	..	..	..	..	..	..	..
Residuals, D, E, F	5.5-6.75	3.5-4.5	0.04-0.08	..	0.3-0.8	..	..	..	..	..	..
max total 40	balance	balance	balance	balance	balance	balance	balance	balance	balance	balance	balance
Titanium ^g	0.08	0.25	0.03	0.015	0.30	..	..	..	0.08-0.14	..	0.1 0.4
26	..	..	..	..	..	..	..	..	..	..	0.1 0.4

Element	Composition, %			
	Grade 26-	Grade 26H -	Grade 27-	Grade 28-
26H	Grade 26- 940.08	Grade 26H - Grade 30.25	Grade 27- Grade 36	Grade 28- Grade 37
Nitrogen, max	0.03	0.03	0.03	0.03
Nitrogen, max	0.03	0.015	0.30	..
Carbon, max	0.08	0.08	0.08	0.08