



Designation: B363 – 19

# Standard Specification for Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings<sup>1</sup>

This standard is issued under the fixed designation B363; 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.

*This standard has been approved for use by agencies of the U.S. Department of Defense.*

## 1. Scope\*

1.1 This specification<sup>2</sup> covers fittings intended for general corrosion-resisting and elevated-temperature services, factory made from unalloyed titanium and titanium alloys. The term welding fittings applies to parts such as 45° and 90° elbows, 180° returns, caps, tees, reducers, lap-joint stub ends, and other types.

1.2 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

### 2.1 ASTM Standards:<sup>3</sup>

- [B265 Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate](#)
- [B338 Specification for Seamless and Welded Titanium and Titanium Alloy Tubes for Condensers and Heat Exchangers](#)
- [B348 Specification for Titanium and Titanium Alloy Bars and Billets](#)
- [B367 Specification for Titanium and Titanium Alloy Castings](#)

[B381 Specification for Titanium and Titanium Alloy Forgings](#)

[B600 Guide for Descaling and Cleaning Titanium and Titanium Alloy Surfaces](#)

[B861 Specification for Titanium and Titanium Alloy Seamless Pipe](#)

[B862 Specification for Titanium and Titanium Alloy Welded Pipe](#)

### 2.2 ANSI Standards:<sup>4,5</sup>

[ASME/ANSI B16.5 Pipe Flanges and Flanged Fittings](#)

[ASME/ANSI B16.9 Wrought Steel Butt-Welding Fittings](#)

[ASME/ANSI B16.11 Forged Fittings, Socket Welding and Threaded](#)

[ASME/ANSI B36.19 Stainless Steel Pipe](#)

### 2.3 Manufacturers' Standardization Society of the Valve and Fittings Industry Standards:<sup>6</sup>

[MSS SP-25 Standard Marking System for Valves, Fittings, Flanges and Unions](#)

[MSS SP-43 Standard Practice for Light Weight Stainless Steel Butt-Welding Fittings](#)

[MSS SP-97 Standard Integrally Reinforced Forged Branch Outlet Fittings — Socket Welding, Threaded, and Butt-Welding Ends](#)

[MSS SP-119 Standard Factory-Made Wrought Belled End Socket-Welding Fittings](#)

### 2.4 ASME Standard:<sup>7</sup>

[ASME Boiler and Pressure Vessel Code Sections VIII Division 1 Pressure Vessels and Section IX](#)

<sup>1</sup> 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.

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<sup>2</sup> For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-363 in Section II of that Code.

<sup>3</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* volume information, refer to the standard's Document Summary page on the ASTM website.

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

<sup>5</sup> Specifications in the order are for "dimensions only" with no requirements for strength or pressure rating to be inferred. (that is, Class XXXX is not intended to designate a strength or pressure rating requirement for titanium; only to define a dimension for that category.)

<sup>6</sup> Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, <http://www.msshq.com>.

<sup>7</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990, <http://www.asme.org>.

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

### 3. Ordering Information

3.1 Orders for material to this specification shall include the following information as required:

- 3.1.1 Quantity,
- 3.1.2 Grade number,
- 3.1.3 Pipe size and schedule,
- 3.1.4 Method of manufacture and finish,
- 3.1.5 Restrictive chemistry, if desired,
- 3.1.6 Nondestructive tests,
- 3.1.7 Packaging,
- 3.1.8 Inspection and required reports,
- 3.1.9 Appropriate fittings specifications for dimensions only, and
- 3.1.10 Class, as required.

### 4. Material

4.1 The titanium for welding fittings may consist of billets, bars, plates, castings, seamless or welded pipe or tube that conforms to all the requirements for manufacturing process, testing, chemical composition, and mechanical properties prescribed in Specifications **B861** and **B862** for the particular grades referred to in **Table 1**.

### 5. Manufacture

5.1 Forging, forming, or shaping operations may be performed by hammering, pressing, piercing, extruding, upsetting, rolling, bending, fusion welding, or by a combination of two or

**TABLE 2 Permissible Variations in Product Analysis**

Element	Product Analysis Limits, max or Range, %	Permissible Variation in Product Analysis
Aluminum	0.5 to 2.5	±0.20
Aluminum	2.5 to 6.75	±0.40
Carbon	0.10	+0.02
Chromium	0.1 to 0.2	±0.02
Chromium	5.5 to 6.5	±0.30
Hydrogen	0.02	+0.002
Iron	0.80	+0.15
Iron	1.2 to 1.8	±0.20
Molybdenum	0.2 to 0.4	±0.03
Molybdenum	1.5 to 4.5	±0.20
Molybdenum	14.0 to 16.0	±0.50
Nickel	0.3 to 0.9	±0.05
Niobium	2.2 to 3.2	±0.15
Niobium	>30	±0.50
Nitrogen	0.05	+0.02
Oxygen	0.30	+0.03
Oxygen	0.31 to 0.40	±0.04
Palladium	0.01 to 0.02	±0.002
Palladium	0.04 to 0.08	±0.005
Palladium	0.12 to 0.25	±0.02
Ruthenium	0.02 to 0.04	±0.005
Ruthenium	0.04 to 0.06	±0.005
Ruthenium	0.08 to 0.14	±0.01
Silicon	0.06 to 0.40	±0.02
Vanadium	2.0 to 4.5	±0.15
Vanadium	7.5 to 8.5	±0.40
Zirconium	3.5 to 4.5	±0.20
Residuals <sup>A</sup> (each)	0.15	+0.02

<sup>A</sup> A residual is an element present in a metal or alloy in small quantities and is inherent to the manufacturing process but not added intentionally. In titanium these elements include aluminum, vanadium, tin, iron, chromium, molybdenum, niobium, zirconium, hafnium, bismuth, ruthenium, palladium, yttrium, copper, silicon, cobalt, tantalum, nickel, boron, manganese, and tungsten.

**TABLE 1 Permissible Raw Materials**

Grade <sup>A</sup>	Product and ASTM Designation					
	Pipe	Tube	Plate	Bar and Billet	Casting	Forging
WPT1	<b>B861/B862</b> Grade 1	<b>B338</b> Grade 1	<b>B265</b> Grade 1	<b>B348</b> Grade 1	<b>B367</b> Grade C1	<b>B381</b> Grade F-1
WPT2	<b>B861/B862</b> Grade 2	<b>B338</b> Grade 2	<b>B265</b> Grade 2	<b>B348</b> Grade 2	<b>B367</b> Grade C2	<b>B381</b> Grade F-2
WPT2H	<b>B861/B862</b> Grade 2H	<b>B338</b> Grade 2H	<b>B265</b> Grade 2H	<b>B348</b> Grade 2H	...	<b>B381</b> Grade F-2H
WPT3	<b>B861/B862</b> Grade 3	<b>B338</b> Grade 3	<b>B265</b> Grade 3	<b>B348</b> Grade 3	<b>B367</b> Grade C3	<b>B381</b> Grade F-3
WPT7	<b>B861/B862</b> Grade 7	<b>B338</b> Grade 7	<b>B265</b> Grade 7	<b>B348</b> Grade 7	<b>B367</b> Grade C7	<b>B381</b> Grade F-7
WPT7H	<b>B861/B862</b> Grade 7H	<b>B338</b> Grade 7H	<b>B265</b> Grade 7H	<b>B348</b> Grade 7H	...	<b>B381</b> Grade F-7H
WPT9	<b>B861/B862</b> Grade 9	<b>B338</b> Grade 9	<b>B265</b> Grade 9	<b>B348</b> Grade 9	...	<b>B381</b> Grade F-9
WPT11	<b>B861/B862</b> Grade 11	<b>B338</b> Grade 11	<b>B265</b> Grade 11	<b>B348</b> Grade 11	<b>B367</b> Grade C11	<b>B381</b> Grade F-11
WPT12	<b>B861/B862</b> Grade 12	<b>B338</b> Grade 12	<b>B265</b> Grade 12	<b>B348</b> Grade 12	...	<b>B381</b> Grade F-12
WPT13	<b>B861/B862</b> Grade 13	<b>B338</b> Grade 13	<b>B265</b> Grade 13	<b>B348</b> Grade 13	...	<b>B381</b> Grade F-13
WPT14	<b>B861/B862</b> Grade 14	<b>B338</b> Grade 14	<b>B265</b> Grade 14	<b>B348</b> Grade 14	...	<b>B381</b> Grade F-14
WPT15	<b>B861/B862</b> Grade 15	<b>B338</b> Grade 15	<b>B265</b> Grade 15	<b>B348</b> Grade 15	...	<b>B381</b> Grade F-15
WPT16	<b>B861/B862</b> Grade 16	<b>B338</b> Grade 16	<b>B265</b> Grade 16	<b>B348</b> Grade 16	...	<b>B381</b> Grade F-16
WPT16H	<b>B861/B862</b> Grade 16H	<b>B338</b> Grade 16H	<b>B265</b> Grade 16H	<b>B348</b> Grade 16H	...	<b>B381</b> Grade F-16H
WPT17	<b>B861/B862</b> Grade 17	<b>B338</b> Grade 17	<b>B265</b> Grade 17	<b>B348</b> Grade 17	...	<b>B381</b> Grade F-17
WPT18	<b>B861/B862</b> Grade 18	<b>B338</b> Grade 18	<b>B265</b> Grade 18	<b>B348</b> Grade 18	...	<b>B381</b> Grade F-18
WPT19	<b>B861/B862</b> Grade 19	...	<b>B265</b> Grade 19	<b>B348</b> Grade 19	...	<b>B381</b> Grade F-19
WPT20	<b>B861/B862</b> Grade 20	...	<b>B265</b> Grade 20	<b>B348</b> Grade 20	...	<b>B381</b> Grade F-20
WPT21	<b>B861/B862</b> Grade 21	...	<b>B265</b> Grade 21	<b>B348</b> Grade 21	...	<b>B381</b> Grade F-21
WPT23	<b>B861/B862</b> Grade 23	...	<b>B265</b> Grade 23	<b>B348</b> Grade 23	...	<b>B381</b> Grade F-23
WPT24	<b>B861/B862</b> Grade 24	...	<b>B265</b> Grade 24	<b>B348</b> Grade 24	...	<b>B381</b> Grade F-24
WPT25	<b>B861/B862</b> Grade 25	...	<b>B265</b> Grade 25	<b>B348</b> Grade 25	...	<b>B381</b> Grade F-25
WPT26	<b>B861/B862</b> Grade 26	<b>B338</b> Grade 26	<b>B265</b> Grade 26	<b>B348</b> Grade 26	...	<b>B381</b> Grade F-26
WPT26H	<b>B861/B862</b> Grade 26H	<b>B338</b> Grade 26H	<b>B265</b> Grade 26H	<b>B348</b> Grade 26H	...	<b>B381</b> Grade F-26H
WPT27	<b>B861/B862</b> Grade 27	<b>B338</b> Grade 27	<b>B265</b> Grade 27	<b>B348</b> Grade 27	...	<b>B381</b> Grade F-27
WPT28	<b>B861/B862</b> Grade 28	<b>B338</b> Grade 28	<b>B265</b> Grade 28	<b>B348</b> Grade 28	...	<b>B381</b> Grade F-28
WPT33	<b>B861/B862</b> Grade 33	<b>B338</b> Grade 33	<b>B265</b> Grade 33	<b>B348</b> Grade 33	...	<b>B381</b> Grade F-33
WPT34	<b>B861/B862</b> Grade 34	<b>B338</b> Grade 34	<b>B265</b> Grade 34	<b>B348</b> Grade 34	...	<b>B381</b> Grade F-34
WPT35	<b>B861/B862</b> Grade 35	<b>B338</b> Grade 35	<b>B265</b> Grade 35	<b>B348</b> Grade 35	...	<b>B381</b> Grade F-35
WPT36	<b>B861/B862</b> Grade 36	<b>B338</b> Grade 36	<b>B265</b> Grade 36	<b>B348</b> Grade 36	...	<b>B381</b> Grade F-36
WPT37	<b>B861/B862</b> Grade 37	<b>B338</b> Grade 37	<b>B265</b> Grade 37	<b>B348</b> Grade 37	...	<b>B381</b> Grade F-37
WPT38	<b>B861/B862</b> Grade 38	<b>B338</b> Grade 38	<b>B265</b> Grade 38	<b>B348</b> Grade 38	...	<b>B381</b> Grade F-38

<sup>A</sup> When fittings are of welded construction, the symbol shown shall be supplemented by the letter "W."