Designation: B363 – 14

Standard Specification for Seamless and Welded Unalloyed Titanium and Titanium Alloy Welding Fittings[1]

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 (ε) 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[2] 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 butt-welding 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

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:*[4,5]

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:*[6]

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:*[7]

ASME Boiler and Pressure Vessel Code Sections VIII Division 1 Pressure Vessels and Section IX

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,

[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.

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[2] For ASME Boiler and Pressure Vessel Code applications, see related Specification SB-363 in Section II of that Code.

[3] 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.

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

[5] 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.)

[6] Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602, http://www.mss-hq.com.

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

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 more of these operations. The forming procedure shall be so applied that it will not produce injurious defects in the fittings.

5.2 Fittings containing welded seams or other joints made by fusion welding shall comply with the following provision:

5.2.1 Welded by welders, welding operators, and welding procedures qualified under the provisions of Section IX of the ASME Boiler and Pressure Vessel Code.

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[A] (each)	0.15	+0.02

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

[A] When fittings are of welded construction, the symbol shown shall be supplemented by the letter "W."

NOTE 1—Annealing of the unalloyed and alloyed grades of titanium covered by this specification is for the purpose of assuring uniform properties.

6. Chemical Composition

6.1 The titanium shall conform to the requirements as to chemical composition prescribed in the specifications referred to in Table 1.

6.2 The chemical analysis of the components of the fittings need not be reported unless required by agreement between the manufacturer and the purchaser and so specified on the order.

7. Product Analysis

7.1 Product analysis may be made by the purchaser from one or more fittings in each lot.

NOTE 2—Definition of the term "lot" shall be as agreed upon between the manufacturer and the purchaser.

7.2 Product analysis tolerances do not broaden the specified heat analysis requirements, but cover variations between different laboratories in the measurement of chemical content. The manufacturer shall not ship material that is outside the limits specified for the applicable grade. Product analysis tolerances shall be as specified in Table 2.

8. Tensile Properties

8.1 The titanium shall conform to the requirements as to tensile properties prescribed in the specifications referred to in Table 1.

8.2 Tensile tests of the finished fittings need not be reported unless required by agreement between the manufacturer and the purchaser and so stated in the order.

9. Workmanship, Finish, and Appearance

9.1 For fittings covered by ASME/ANSI B16.5, ASME/ANSI B16.9 or ASME/ANSI B16.11, MSS SP-43, MSS SP-97, or MSS SP-119 or for fittings to be used with pipe ordered to ASME/ANSI B36.19, or as attachments such as caps, plugs, etc., the sizes, shapes, and dimensions of the fittings shall be as specified in those standards.

9.2 The fittings shall have a workmanlike finish and shall be free of injurious external and internal imperfections of a nature that will interfere with the purpose for which the fittings are intended. Minor defects may be removed by grinding, providing the wall thickness is not decreased to less than the minimum thickness, and further provided that the ground-out area shall be faired out.

10. Hydrostatic Tests

10.1 All fittings shall be capable of withstanding without failure, leakage, or impairment of their serviceability, a test pressure prescribed in the specifications for the pipe or tubing with which the fitting is recommended to be used (see Table 1). For sizes outside the capability for hydrostatic testing, consideration should be given to radiographic inspection in accordance with Section S2 under Supplementary Requirements.

10.2 Hydrostatic tests need not be performed or reported, unless required by agreement between the manufacturer and the purchaser and so stated on the order.

11. Inspection and Certification

11.1 Inspection by the purchaser prior to shipment shall be specified in the purchase order.

11.2 The manufacturer shall afford the inspector, without charge, all reasonable facilities to satisfy him that the fittings are being furnished in accordance with this specification. Any tests (except product analysis) and inspection agreed upon and so stated in the purchase order shall be made at the place of manufacture, unless otherwise specified, and shall be so conducted as not to interfere unnecessarily with the operation of the works.

11.3 *Certification*—When specified in the order, the manufacturer shall furnish the purchaser a certificate that the finished fittings conform to the requirements of this specification.

NOTE 3—It is recognized that a sensitive surface inspection of the welds or base metal, or both, is advisable for some services. See Supplementary Requirements.

12. Rejection

12.1 Material not conforming to this specification or to authorized modifications shall be subject to rejection. Unless otherwise specified, rejected material may be returned to the manufacturer at the manufacturer's expense, unless the purchaser receives, within 3 weeks of notice of rejection, other instructions for disposition.

13. Product Marking

13.1 The manufacturer's name or trademark, the schedule number, material, and size shall be stamped (Note 4), stenciled, electroetched, or otherwise suitably marked on each fitting. In addition, each fitting shall be marked with the identification symbol and suffix for the respective specification listed in Table 1. On wall thicknesses thinner than Schedule 40S, no stamps or other indented markings shall be used. When the size does not permit complete marking, identification marks may be omitted in the sequence shown in MSS SP-25.

NOTE 4—When steel stamps are used, they should be applied prior to heat treatment and care should be taken so that the marking is not deep enough to cause cracks or to reduce the wall thickness of the fitting below the minimum allowed.

14. Keywords

14.1 fittings; seamless fittings; titanium; titanium alloy; welded fittings

SUPPLEMENTARY REQUIREMENTS

Supplementary requirements shall not be considered unless specified in the order, in which event the test shall be made by the manufacturer at the purchaser's expense.

S1. Surface Inspection

S1. Liquid penetrant inspection may be performed on all outside-diameter surfaces of the fittings and inside-diameter surfaces where practicable. An acceptance standard may be agreed upon between the manufacturer and the purchaser prior to the acceptance of the order.

S2. Radiographic Inspections of Welds

S2.1 Radiographic inspection may be performed on all weldments of the fittings in accordance with paragraph UW-51, Section VIII of the ASME Boiler and Pressure Vessel Code.

S3. Stress Relief Heat Treatment

S3.1 The stress-relieving treatment shall consist of holding the fitting at a minimum temperature of 1100°F for not less than ½ h/in. of thickness.

S3.2 Minimum time at temperature is 15 min. All parts stress relieved shall be subsequently cleaned and free of oxide scale contamination (see Guide B600).

S4. Certification of Material Incorporated in the Manufacture of the Fittings

S4.1 All material incorporated within the fitting shall be documented and shall be in accordance with the applicable documents in Table 1.