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

This standard is issued under the fixed designation B 653/B 653M; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

### 1. Scope

1.1 This specification covers fittings, factory made from three grades of zirconium and zirconium 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 The values stated in either inch-pound units or SI units are to be regarded separately as the standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with the specification.

1.3 *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:<sup>2</sup>

B 493 Specification for Zirconium and Zirconium Alloy Forgings

B 523/B 523M Specification for Seamless and Welded Zirconium and Zirconium Alloy Tubes

B 550/B 550M Specification for Zirconium and Zirconium Alloy Bar and Wire

B 551/B 551M Specification for Zirconium and Zirconium Alloy Strip, Sheet, and Plate

B 614 Practice for Descaling and Cleaning Zirconium and Zirconium Alloy Surfaces

B 658/B 658M Specification for Seamless and Welded Zirconium and Zirconium Alloy Pipe

#### 2.2 ANSI Standards:

B16.9 Wrought Steel Butt-Welding Fittings<sup>3</sup>

B36.19 Stainless Steel Pipe<sup>3</sup>

#### 2.3 Manufacturers' Standardization Society of the Valve and Fittings Industry Standards:

SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions<sup>4</sup>

SP-43 Standard Practice for Light Weight Stainless Steel Fittings<sup>4</sup>

#### 2.4 American Society of Mechanical Engineers:

ASME Boiler and Pressure Vessel Code, Sections VIII and IX<sup>5</sup>

### 3. Terminology

#### 3.1 Lot Definitions:

3.1.1 *castings*—a lot shall consist of all castings produced from the same pour.

3.1.2 *ingot*—no definition required.

3.1.3 *rounds, flats, tubes, and wrought powder metallurgical products (single definition, common to nuclear and non-nuclear standards)*—a lot shall consist of a material of the same size, shape, condition, and finish produced from the same ingot or powder blend by the same reduction schedule and the same heat treatment parameters. Unless otherwise agreed between manufacturer and

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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 02.04, volume information, refer to the standard's Document Summary page on the ASTM website.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036.

<sup>4</sup> Available from Manufacturers Standardization Society of the Valve and Fittings Industry (MSS), 127 Park St., NE, Vienna, VA 22180-4602.

<sup>5</sup> Available from American Society of Mechanical Engineers (ASME), ASME International Headquarters, Three Park Ave., New York, NY 10016-5990.

purchaser, a lot shall be limited to the product of an 8 h period for final continuous anneal, or to a single furnace loaf for final batch anneal.

~~3.1.4 sponge~~—a lot shall consist of a single blend produced at one time.

~~3.1.5 weld fittings~~ weld fittings, *n*—definition is to be mutually agreed upon between manufacturer and the purchaser.

#### 4. Classification

4.1 The fittings are furnished in three grades as follows:

4.1.1 ~~Grade R60702~~ Grade R60702 (PZ 2)—Unalloyed zirconium.

4.1.2 ~~Grade R60704~~ Grade R60704 (PZ 4)—Zirconium-tin.

4.1.3 ~~Grade R60705~~ Grade R60705 (PZ 5)—Zirconium-niobium.

#### 5. Ordering Information

5.1 Orders for materials under this specification shall include the following information:

5.1.1 Quantity,

5.1.2 Name of material (zirconium fittings),

5.1.3 Grade number (see 4.1),

5.1.4 ASTM designation and year of issue,

~~5.1.5 Finish (see Section~~

~~5.1.5~~ Hydrostatic test requirements (see 10.2),

~~5.1.6~~ Inspection requirements (see 11.1),

~~5.1.7~~ Finish (see Section 9), and

~~5.1.6~~ Additions to the specification and supplementary requirements, if required.

NOTE 1—A typical ordering description is as follows: 15 pieces, zirconium, 4-in. (~~400 mm~~), [100 mm], Schedule 40, 90° long radius elbows, descaled, ASTM B 653 - 01, Grade R60702. Supplementary Requirement S3, Stress Relief Heat Treatment.

#### 6. Materials and Manufacture

6.1 Forging, forming, or shaping operations may be performed by hammering, pressing, piercing, extruding, upsetting, rolling, bending, fusion welding, machining, or by a combination of these operations. The forming procedure shall be so applied that it will not produce injurious defects in the fittings.

6.2 Fittings containing welded seams or other joints made by welding shall comply with the following provisions:

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

6.2.2 Filler metal, when used, shall be the same grade as the base metal.

~~6.2.3 All welds on grade R60705 shall be stress relief annealed within 14 days after welding to prevent delayed hydride cracking.~~

6.2.3 All welds on grade R60705 shall be stress relief annealed within 14 days after welding to prevent delayed hydride cracking, in accordance with Supplementary Requirements Section S3, Stress Relief Heat Treatment.

#### 7. Chemical Composition

7.1 The material shall conform to the requirements as to chemical composition prescribed in Table 1.

~~7.2 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 stated in the purchase order.~~

#### 8. Tensile Requirements

8.1 The material shall conform to the requirements as to the tensile properties prescribed in Table 1.

**TABLE 1 Permissible Raw Materials**

Grade <sup>A</sup>	Product and ASTM Designation				
	Pipe	Tube	Plate	Bar	Forging
PZ-2	B-658 Grade R60702	B-523 Grade R60702	B-551 Grade R60702	B-550 Grade R60702	B-493 Grade R60702
PZ 2 (R60702)	B 658/B 658M Grade R60702	B 523/B 523M Grade R60702	B 551/B 551M Grade R60702	B 550/B 550M Grade R60702	B 493 Grade R60702
PZ-4	B-658 Grade R60704	B-523 Grade R60704	B-551 Grade R60704	B-550 Grade R60704	B-493 Grade R60704
PZ 4 (R60704)	B 658/B 658M Grade R60704	B 523/B 523M Grade R60704	B 551/B 551M Grade R60704	B 550/B 550M Grade R60704	B 493 Grade R60704
PZ-5	B-658 Grade R60705	B-523 Grade R60705	B-551 Grade R60705	B-550 Grade R60705	B-493 Grade R60705
PZ 5 (R60705)	B 658/B 658M Grade R60705	B 523/B 523M Grade R60705	B 551/B 551M Grade R60705	B 550/B 550M Grade R60705	B 493 Grade R60705

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