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## **SPECIFICATION FOR SEAMLESS AND WELDED ZIRCONIUM AND ZIRCONIUM ALLOY WELDING FITTINGS**



**SB-653/SB-653M**

(Identical with ASTM Specification B653/B653M-11 except that the following additional requirements apply.)

All fittings welded with filler metal intended for applications under the rules of Section VIII, Division 1 of the ASME Boiler and Pressure Vessel Code shall conform to the following: Manufacturer of such products are limited to manufacturers holding the appropriate ASME Certificate of Authorization and Code Certification Mark. In addition to conforming to this specification, the manufacturer shall meet all applicable requirements of Section VIII, Division 1 of the Code. The materials used to fabricate the fitting shall conform to ASME SB Specifications. The product shall be subject to all applicable requirements of Section VIII, Division 1 of the Code, including welding, heat treatment, nondestructive examination, authorized inspections at point of manufacture, and application of the Code Certification Mark.

The applicable ASME Partial Data Report Form signed by an Authorized Inspector and a certified mill test report shall be furnished for each lot of fittings. The term "lot" applies to all fittings of the same mill heat of material, size, and wall thickness, which are heat treated, if applicable, in one furnace charge. Each fitting shall be marked in such a manner to identity each such piece with the "lot" and the certified mill test report.

# Standard Specification for Seamless and Welded Zirconium and Zirconium Alloy Welding Fittings

## 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:*  
B493 Specification for Zirconium and Zirconium Alloy Forgings  
B523/B523M Specification for Seamless and Welded Zirconium and Zirconium Alloy Tubes  
B550/B550M Specification for Zirconium and Zirconium Alloy Bar and Wire  
B551/B551M Specification for Zirconium and Zirconium Alloy Strip, Sheet, and Plate  
B614 Practice for Descaling and Cleaning Zirconium and Zirconium Alloy Surfaces  
B658/B658M Specification for Seamless and Welded Zirconium and Zirconium Alloy Pipe

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## 2.2 *ANSI Standards:*

- B16.9 Wrought Steel Butt-Welding Fittings  
B36.19 Stainless Steel Pipe

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

- SP-25 Standard Marking System for Valves, Fittings, Flanges, and Unions  
SP-43 Standard Practice for Light Weight Stainless Steel Fittings

## 2.4 *American Society of Mechanical Engineers:*

- ASME Boiler and Pressure Vessel Code, Sections VIII and IX

## 3. Terminology

### 3.1 *Lot Definitions:*

3.1.1 *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 (PZ 2)*—Unalloyed zirconium.  
4.1.2 *Grade R60704 (PZ 4)*—Zirconium-tin.  
4.1.3 *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 Hydrostatic test requirements (see 10.2),  
5.1.6 Inspection requirements (see 11.1),

5.1.7 Finish (see Section 9), and

5.1.8 Additions to the specification and supplementary requirements, if required.

NOTE 1—A typical ordering description is as follows: 15 pieces, zirconium, 4-in. [100 mm], Schedule 40, 90° long radius elbows, descaled, ASTM B653 - 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, 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.

**8. Tensile Requirements**

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

**9. Workmanship, Finish, and Appearance**

9.1 For fittings covered by ANSI B16.9 or MSS SP-43, or for fittings to be used with pipe ordered to ANSI B36.19, the sizes, shapes, and dimensions of the fittings shall be as specified in those standards.

9.2 The fittings 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 applicable standards in Table 1 for the pipe or tubing with which the fitting is planned to be used.

10.2 Hydrostatic tests shall be performed when required by the purchase order.

**11. Inspection**

11.1 The manufacturer shall inspect the material covered by this specification prior to shipment. If so specified in the purchase order, the purchaser or his representative may witness the testing and inspection of the material at the place of manufacture. In such cases the purchaser shall state in his purchase order which tests he desires to witness. The manufacturer shall give ample notice to the purchaser as to the time and place of the designated tests. If the purchaser's representative does not present himself at the time agreed upon for the testing, the manufacturer shall consider the requirement for the purchaser's inspection at the place of manufacture to be waived.

11.2 The manufacturer shall afford the inspector representing the purchaser, without charge, all reasonable facilities to satisfy him that the material is being furnished in accordance with this specification. This inspection shall be so conducted as not to interfere unnecessarily with the operation of the works.

**12. Rejection**

12.1 Rejection for failure of the material to meet the requirements of this specification shall be reported to the manufacturer. Unless otherwise specified, rejected material may be returned to the manufacturer at the manufacturer's expense, unless the purchaser receives, within three weeks of the notice of rejection, other instructions for disposition.

**13. Certification**

13.1 A producer or supplier shall furnish the purchaser with a certificate that the material was manufactured, sampled, tested, and inspected in accordance with this specification and has been found to meet the requirements. The certificate shall include a report of the test results.

13.2 All material incorporated within the fitting shall be identified and shall be in accordance with the applicable standards in Table 1.

**TABLE 1 Permissible Raw Materials**

Grade <sup>A</sup>	Product and ASTM Designation				
	Pipe	Tube	Plate	Bar	Forging
PZ 2 (R60702)	B658/B658M Grade R60702	B523/B523M Grade R60702	B551/B551M Grade R60702	B550/B550M Grade R60702	B493 Grade R60702
PZ 4 (R60704)	B658/B658M Grade R60704	B523/B523M Grade R60704	B551/B551M Grade R60704	B550/B550M Grade R60704	B493 Grade R60704
PZ 5 (R60705)	B658/B658M Grade R60705	B523/B523M Grade R60705	B551/B551M Grade R60705	B550/B550M Grade R60705	B493 Grade R60705

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

#### 14. Referee

14.1 In the event of disagreement between the manufacturer and the purchaser on the conformance of the material to the requirements of this specification or any special test specified by the purchaser, a mutually acceptable referee shall perform the tests in question. The results of the referee's testing shall be used in determining conformance of the material to this specification.

#### 15. Product Marking

15.1 Unless otherwise specified, the manufacturer's name or trademark, the schedule number, material, and size shall be stamped (see Note 2), stenciled, electroetched, or otherwise suitably marked on each fitting. In addition, each fitting shall be marked with the identification grade symbol and suffix for the respective specification listed in Table 1. On wall thick-

nesses 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 2—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.

#### 16. Packaging and Package Marking

16.1 The fittings shall be packaged suitably in such a manner as to assure safe delivery to its destination when properly transported by common carrier.

#### 17. Keywords

17.1 fitting; pipe; zirconium; zirconium alloy

### 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

S1.1 Liquid penetrant inspection may be performed on all outside-diameter surfaces of the fittings and inside-diameter surfaces where practicable. Acceptance shall be in accordance with Appendix 8, Section VIII of the ASME Boiler and Pressure Vessel Code.

#### 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 [600°C] for not less than 30 min per inch [25 mm] of the maximum thickness in a nonreducing atmosphere.

S3.2 The minimum time at this temperature is 15 min. All stress-relieved parts shall be cleaned subsequently and shall be free of oxide scale contamination (see Practice B614).