Designation: B752/B752M – 18

Standard Specification for Castings, Zirconium-Base, Corrosion Resistant, for General Application[1]

This standard is issued under the fixed designation B752/B752M; 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 zirconium and zirconium-alloy castings for general corrosion-resistant and industrial applications.

1.2 The values stated in either inch-pound units or SI units are to be regarded separately as standard. Within the text, the SI units are shown in brackets. The values stated in each system are not exact equivalents; therefore, each system shall be used independently of each other. Combining values from the two systems may result in nonconformance with this specification.

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:*[2]

A802/A802M Practice for Steel Castings, Surface Acceptance Standards, Visual Examination

E8/E8M Test Methods for Tension Testing of Metallic Materials

E10 Test Method for Brinell Hardness of Metallic Materials

E18 Test Methods for Rockwell Hardness of Metallic Materials

E23 Test Methods for Notched Bar Impact Testing of Metallic Materials

E94 Guide for Radiographic Examination Using Industrial Radiographic Film

E165 Practice for Liquid Penetrant Examination for General Industry

E446 Reference Radiographs for Steel Castings Up to 2 in. (50.8 mm) in Thickness

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *pour, n*—shall consist of all material melted and cast at one time.

3.2 *Lot Definitions:*

3.2.1 *castings, n*—a lot shall consist of all castings produced from the same pour.

4. Ordering Information

4.1 Orders for castings to this specification shall include the following, as required to describe the requirements adequately.

4.1.1 Description of the castings by pattern number or drawing (dimensional tolerances shall be included on the casting drawing),

4.1.2 Quantity,

4.1.3 Grade Designation (see Table 1),

4.1.4 Options in the specification, and

4.1.5 Supplementary requirements desired, including the standards of acceptance.

5. Materials and Manufacture

5.1 Material for this specification shall be melted by conventional processes used for reactive metals. Typical methods include the consumable electrode and inductoslag melting processes.

6. Chemical Composition

6.1 *Pour Analysis*—An analysis of each pour shall be made by the producer from a sample such as a casting or test bar that is representative of the pour. The chemical composition determined shall conform to the requirements specified for the relevant grade in Table 1.

6.1.1 The elements listed in Table 1 are intentional alloying additions of elements which are inherent to the manufacture of primary zirconium, zirconium sponge, mill product or castings.

6.1.1.1 Elements other than those listed in Table 1 are deemed to be capable of occurring in the grades listed in Table 1 by and only by way of unregulated or unanalyzed scrap

[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 B10.02 on Zirconium and Hafnium.

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[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.

TABLE 1 Chemical Requirements[A]

	Grade Designation, Composition, %		
	702C	704C	705C
Zirconium and hafnium, min.	98.8	97.1	95.1
Hafnium, max	4.5	4.5	4.5
Iron and chromium, max	0.3	0.3	0.3
Hydrogen, max	0.005	0.005	0.005
Nitrogen, max	0.03	0.03	0.03
Carbon, max	0.1	0.1	0.1
Oxygen, max	0.25	0.3	0.3
Phosphorus, max	0.01	0.01	0.01
Tin	...	1.0 to 2.0	...
Niobium	...	...	2.0 to 3.0

[A] By agreement between the purchaser and the producer, analysis may be required and limits established for elements and compounds not specified in this table.

additions to the pour. Therefore, pour analysis for elements not listed in Table 1 shall be considered to be in excess of the intent of this specification.

6.2 When agreed upon by producer and purchaser and requested by the purchaser in his written purchase order, chemical analysis shall be completed for specific residual elements not listed in this specification.

6.3 *Product Analysis*—A product analysis may be made by the purchaser on a representative casting from any lot. Because of the possibility of oxygen or other interstitial contamination, samples for oxygen, carbon, hydrogen, and nitrogen analysis shall be taken no closer than ¼ in. [6.3 mm] to a cast surface except that castings too thin for this shall be analyzed on representative material. The chemical composition determined shall conform to the analysis in Table 1 within the check analysis variations shown in Table 2 or shall be subject to rejection by the purchaser.

6.4 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 purchase, 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.

TABLE 2 Check Analysis Tolerances

Element	Maximum of Range, Weight, %	Permissible Variation in Check Analysis
Nitrogen	0.03	+0.006
Carbon	0.10	+0.02
Hydrogen	0.005	+0.001
Iron and chromium	0.30	+0.06
Oxygen	0.25	+0.05
Hafnium	4.50	+0.50
Phosphorus	0.010	+0.003
Tin	1.0 to 2.0	±0.02
Niobium	2.0 to 3.0	±0.015
Residuals	0.10	+0.02

7. Heat Treatment

7.1 Unless otherwise specified in the contract, all castings will be supplied in the as-cast condition except when post-weld heat treatment is required.

7.2 If post-weld heat treatment is required, it shall consist of a stress relief performed at 1050 ± 50°F [565 ± 25°C] for a minimum of ½ h at temperature plus an additional ½ h at temperature per inch of thickness for section sizes greater than 1 in. [25 mm]. After heat treatment, the castings should be cooled in air or in the furnace to ambient temperature unless otherwise agreed upon between the purchaser and producer.

8. Workmanship, Finish, and Appearance

8.1 All castings shall be made in a workmanlike manner and shall conform to the dimensions in drawings furnished by the purchaser before manufacturing is started. If the pattern is supplied by the purchaser, the dimensions of the casting shall be as predicted by the pattern.

8.2 The surface of the casting shall be free of adhering mold material, scale, cracks, and hot tears as determined by visual examination. Other surface discontinuities shall meet the visual acceptance standards specified in the order. Practice A802/A802M or other visual standards may be used to define acceptable surface discontinuities and finish. Unacceptable surface discontinuities shall be removed, and their removal verified by visual examination of the resultant cavities.

9. Repair by Welding

9.1 If repairs are required, these shall be made using a welding procedure and operators certified to quality requirements established by the producer. The procedures developed shall be consistent with standard practices recommended for reactive metal alloys. The producer shall maintain documentation on procedure and welder qualifications. Procedure modifications or special arrangements shall be as agreed upon between the producer and purchaser.

9.2 Weld repairs shall be considered major in the case of a casting that has leaked on a hydrostatic test or when the depth of the cavity after preparation for repair exceeds 20 % of the actual wall thickness or 1 in. [25 mm], whichever is smaller, or when the surface area of the cavity exceeds approximately 10 in.^{2} [6500 mm^2]. All other weld repairs shall be considered minor. Major and minor repairs shall be subject to the same quality standards as are used to inspect the castings.

9.3 The composition of the deposited weld metal shall be within the chemical requirements for each grade established in Table 1.

9.4 All castings with major weld repairs shall be stress relieved after repair in accordance with 7.2. Stress relief after minor repairs is not required for grades 702C and 704C except by agreement between the producer and the purchaser. Grade 705C must be stress relieved after any weld repair.

10. Inspection

10.1 The producer shall afford the purchaser's inspector all reasonable facilities necessary to satisfy him that the material