



Standard Specification for Castings, Zirconium-Base, Corrosion Resistant, for General Application¹

This standard is issued under the fixed designation B 752; 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 inch-pound units are to be regarded as the standard. The values stated in brackets are for information only.

2. Referenced Documents

2.1 ASTM Standards:

A 802/A802M Practice for Steel Castings, Surface Acceptance Standards, Visual Examination²

E 8 Test Methods for Tension Testing of Metallic Materials³

E 10 Test Method for Brinell Hardness of Metallic Materials³

E 18 Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials³

E 94 Guide for Radiographic Testing⁴

E 142 Method for Controlling Quality of Radiographic Testing⁴

E 146 Methods for Chemical Analysis of Zirconium and Zirconium Alloys⁵

E 165 Test Method for Liquid Penetrant Examination⁴

E 446 Reference Radiographs for Steel Castings Up to 2 in. (51 mm) in Thickness⁴

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

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

3.1.2 *pour*—shall consist of all material melted and cast at one time.

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 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.

¹ This specification is under the jurisdiction of ASTM Committee B-10 on Reactive and Refractory Metals and Alloys and is the direct responsibility of Subcommittee B10.05 on Castings.

Current edition approved Oct. 10, 1997. Published February 1998. Originally published as B 752 – 85. Last previous edition B 752 – 91 (1995).

² *Annual Book of ASTM Standards*, Vol 01.02.

³ *Annual Book of ASTM Standards*, Vol 03.01.

⁴ *Annual Book of ASTM Standards*, Vol 03.03.

⁵ Discontinued—see 1990 *Annual Book of ASTM Standards*, Vol 03.05.

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.

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

6.4 *Referee Analysis*— In the event of disagreement between the producer and purchaser concerning the analysis of any casting, Methods E 146 shall be used as a referee chemical analysis method.

7. Heat Treatment

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

7.2 If post-weld heat treatment is required, it shall consist of a stress relief performed at $1050 \pm 50^\circ\text{F}$ [$566 \pm 28^\circ\text{C}$] for a minimum of $\frac{1}{2}$ h at temperature plus an additional $\frac{1}{2}$ 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 A 802/A 802M 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 mm²]. 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 is being produced and furnished in accordance with this specification. Foundry inspection by the purchaser shall not interfere unnecessarily with the producer's operations. All tests and inspections, with the exception of product analysis (6.3), shall be made at the place of manufacture unless otherwise agreed upon.

11. Rejection

11.1 Any rejection based on test reports shall be reported to the producer within 60 days from the receipt of the test reports by the purchaser.

11.2 Material that shows unacceptable discontinuities as determined by the acceptance standards specified on the order, subsequent to acceptance at the producer's works, will be rejected, and the producer shall be notified within 60 days, or as otherwise agreed upon.

12. Product Marking

12.1 Unless otherwise specified, the following shall apply:

12.1.1 Castings shall be marked for material identification with the ASTM specification number (B 752) and grade symbol, that is, 702C, 704C, or 705C.

12.1.2 The producer's name or identification mark and the pattern number shall be cast or stamped using low stress stamps on all castings. Small size castings may be such that marking must be limited consistent with the available area.