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Standard Specification for Primary Zirconium¹

This standard is issued under the fixed designation B 494/B 494M; 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 two grades of zirconium metal commonly designated as sponge or chunklets, but may also take other forms. This specification does not include crystal bar zirconium. This sponge is used in non-nuclear applications.

1.2 Unless a single unit is used, for example corrosion mass gain in mg/dm^2 , the values stated in either inch-pound or SI units are to be regarded separately as standard. The values stated in each system are not exact equivalents; therefore each system must be used independently of the other. SI values cannot be mixed with inch-pound values.

1.3 *The following precautionary caveat pertains only to the test method portions of this specification. 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:*²

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

3. Terminology

~~3.1 Lot Definitions:~~

3.1 Forms:

3.1.1 ~~castings~~—a lot shall consist of all castings produced from the same pour. sponge, n—zirconium metal produced from the reduction of the chloride, usually by magnesium.

3.1.1.1 ~~Discussion~~—The process is one where the metal condenses to the solid state and does not melt.

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 purchaser, a lot shall be limited to the product of an 8 h period for final continuous anneal, or to a single furnace load 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~~—definition is to be mutually agreed upon between manufacturer and the purchaser. chunklets, n—zirconium metal produced from the reduction of the chloride, usually by sodium.

3.1.2.1 ~~Discussion~~—In this process, the reduced metal is melted and dripped onto a rotating disk to form chunklets.

3.2 ~~Lot~~—a lot shall consist of a single blend produced at one time.

4. Classification

4.1 Primary zirconium is furnished in two grades:

4.1.1 *Grade R60702*— Unalloyed zirconium.

4.1.2 *Grade R60703*— Unalloyed zirconium for metallurgical alloying.

5. Ordering Information

5.1 Orders for material under this specification shall include the following information, when applicable:

5.1.1 Quantity (weight),

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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*, Vol 14.02, volume information, refer to the standard's Document Summary page on the ASTM website.

- 5.1.2 Name of material (zirconium sponge or chunklet),
- 5.1.3 Grade number (see 4.1),
- 5.1.4 ASTM designation and year of issue,
- 5.1.5 Check analysis (see 7.2),
- 5.1.6 Sampling of small blends (see 8.1.1),
- 5.1.7 Inspection (see 11.1),
- ~~5.1.8 Certification report (Section 13);~~
- ~~5.1.9 Product marking (Section~~
- 5.1.8 Product marking (Section 15),
- ~~5.1.10 Packaging (Section~~
- 5.1.9 Packaging (Section 16),
- 5.1.10 Oxygen limits, when needed (Table 1), and
- ~~5.1.12 Additions to the specification and supplementary requirements, as required.~~
- 5.1.11 Additions to the specification as required.

NOTE 1—A typical ordering description is as follows: 3000 lb (~~2000 kg~~) [2000 kg] zirconium sponge, ASTM B 494/B 494M - 01, Grade R60703.

6. Materials and Manufacture

6.1 Zirconium metal is usually prepared by reduction of zirconium tetrachloride, and it gets its physical characteristics from the processes involved in production. These characteristics may be expected to vary greatly with manufacturing methods. This specification, however, is not limited to metal prepared by reduction of tetrachloride or to material of any specific physical form.

6.2 Only virgin zirconium metal, in identified, uniform, well-mixed blends, shall be supplied under this specification.

7. Chemical Composition

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

7.2 The purchaser may perform a check analysis for any elements listed in Table 1. The sampling and testing requirements shall be as agreed upon between the purchaser and supplier.

7.2.1 The manufacturer’s analysis shall be considered as verified if the check analysis confirms the manufacturer’s reported values within the tolerances prescribed in Table 2. Practice E 29 shall be used to establish significant digits.

8. Sampling

8.1 *Sampling for Chemical Analysis :*

8.1.1 The following method shall be used for blends of 3000 lb (~~1362 kg~~) [1362 kg] or more. Smaller blends shall be sampled as agreed upon between the manufacturer and the purchaser.

8.1.2 The method shall produce a representative sample amounting to a minimum of 1 % of the quantity sampled. The sample shall be prepared by running the full quantity through a proportioner or splitter so arranged as to give the required amount of sample material. A minimum of 30 lb (~~14 kg~~) [14 kg] of this sample shall be taken to prepare the evaluation ingot described in 10.1.

8.1.3 If analytical samples are required for the determination of magnesium or sodium and chloride, they must be taken from the primary zirconium metal since these constituents are volatilized in melting.

8.1.4 Analytical samples for the determination of impurities other than magnesium or sodium and chloride shall be taken from the evaluation ingot (Sections 8 and 10).

9. Number of Tests and Retests

9.1 *Number of Tests:*

9.1.1 A minimum of three chemical tests shall be performed on the evaluation ingot.

9.1.2 At least one sample shall be analyzed fro magnesium or sodium and chloride.

9.2 *Retests:*

TABLE 1 Chemical Requirements

Element	Composition, %	
	Grade R60702	Grade R60703
Zirconium + hafnium	99.2 min	98.0 min
Zirconium + hafnium	99.2 min	98.0 min
Hafnium	4.5 max	4.5 max
Iron + chromium	0.2 max	...
Hydrogen	0.005 max	...
Nitrogen	0.025 max	...
Carbon	0.05 max	...
Oxygen	^A	^A
Oxygen	^A	^A

^A Limits as specified by the purchaser.