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AMERICAN SOCIETY FOR TESTING AND MATERIALS
100 Barr Harbor Dr., West Conshohocken, PA 19428

Standard Specification for Zirconium and Zirconium Alloy Ingots for Nuclear Application[1]

This standard is issued under the fixed designation B 350/B350M; 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 vacuum-melted zirconium and zirconium alloy ingots for nuclear application.

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 the other. Combining values from the two systems may result in nonconformance with the specification.

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:*

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications[2]

E 114 Practice for Ultrasonic Pulse-Echo Straight-Beam Examination by the Contact Method[3]

3. Classification

3.1 Ingots are furnished in five grades as follows:

3.1.1 R60001 Unalloyed Zirconium,

3.1.2 R60802 Zirconium-Tin Alloy,

3.1.3 R60804 Zirconium-Tin Alloy,

3.1.4 R60901 Zirconium-Niobium Alloy, and

3.1.5 R60904 Zirconium-Niobium Alloy.

4. Ordering Information

4.1 Orders for material under this specification should include the following information as required to describe adequately the desired material:

4.1.1 Quantity in weight or pieces,

4.1.2 Name of material,

4.1.3 Grade (Table 1),

4.1.4 Size (diameter, length, or weight), in the unit system regarded as standard (inch-pound or SI), and

4.1.5 ASTM designation and year of issue.

NOTE 1—A typical ordering description is as follows: two each zirconium ingots, Grade R60001, 12 in. diameter by 1000 lb each, ASTM Specification: B350 – 96.

4.2 In addition to the data specified in 4.1, the following options and points of agreement between the manufacturer and the purchaser should be specified in the purchase order if required:

4.2.1 Inspection (Section 11), and

4.2.2 Oxygen analysis requirements (Table 1).

5. Materials and Manufacture

5.1 Materials covered by this specification shall be produced by multiple vacuum arc melting, or electron beam melting, or other melting processes conventionally used for reactive metals; all melting is to be carried out in furnaces usually used for reactive metals.

6. Condition

6.1 Unless otherwise specified, ingots shall be conditioned by machining or grinding or both to remove surface and subsurface defects detrimental to subsequent fabrication.

6.2 After conditioning has been completed, no abrupt changes in diameter or local depression that will impair subsequent fabrication shall be permitted. The difference between the maximum and minimum radii of the conditioned ingot shall not exceed 20 % of the maximum radius. Lands, grooves, and local depressions shall be blended to a maximum angle of 30 deg to the axis of the ingot. Each end of the ingot shall be chamfered or radiused. The minimum chamfer or radius shall be ½ in. [12 mm].

7. Chemical Requirements

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

7.2 The ingot shall be sampled in sufficient places along the side wall so that the top sample is within 5 in. [125 mm] of the top face and the distance between samples or between the bottom face and a sample does not exceed one ingot diameter. A minimum of three samples per ingot is required.

[1] This specification is under the jurisdiction of ASTM Committee B-10 on Reactive and Refractory Metals and Alloysand is the direct responsibility of Subcommittee B10.02on Zirconium and Hafnium.

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[2] *Annual Book of ASTM Standards*, Vol 14.02.

[3] *Annual Book of ASTM Standards*, Vol 03.03.