



Designation: B 353 – 01<sup>€1</sup>

## Standard Specification for Wrought Zirconium and Zirconium Alloy Seamless and Welded Tubes for Nuclear Service (Except Nuclear Fuel Cladding)<sup>1</sup>

This standard is issued under the fixed designation B 353; 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 reappraisal. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reappraisal.

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<sup>€1</sup> NOTE—Tin content in UNS R60901 and UNS R60904 in Table 1 was editorially corrected in February 2002.

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### 1. Scope

1.1 This specification covers seamless and welded wrought zirconium and zirconium-alloy tubes for nuclear application. Nuclear fuel cladding is covered in Specification B 811.

1.2 Five grades of reactor grade zirconium and zirconium alloys suitable for nuclear application are described.

1.2.1 The present UNS numbers designated for the five grades are given in Table 2.

1.3 Unless a single unit is used, for example corrosion mass gain in mg/dm<sup>2</sup>, 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.

1.4 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:

B 350 Specification for Zirconium and Zirconium Alloy Ingots for Nuclear Application<sup>2</sup>

B 811 Specification for Wrought Zirconium Alloy Seamless Tubes for Nuclear Reactor Fuel Cladding<sup>2</sup>

E 8 Test Methods for Tension Testing of Metallic Materials<sup>3</sup>

E 21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials<sup>3</sup>

E 29 Practice for Using Significant Digits in Test Data to

Determine Conformance with Specifications<sup>4</sup>

E 112 Test Methods for Determining the Average Grain Size<sup>3</sup>

G 2 Test Method for Corrosion Testing of Products of Zirconium, Hafnium, and Their Alloys in Water at 680°F or in Steam at 750°F<sup>5</sup>

G 2M Test Method for Corrosion Testing of Products of Zirconium, Hafnium and Their Alloys in Water at 633K or in Steam at 673K [Metric]<sup>5</sup>

#### 2.2 ANSI Standard:

ANSI B46.1 Surface Texture (Surface Roughness)<sup>6</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *dimensions, n*—tube dimensions are outside diameter, inside diameter, and wall thickness. Only two of these parameters may be specified in addition to length, except minimum wall may be specified with outside and inside diameter. In each case, ovality and wall thickness variation (WTV) may be specified as additional requirements.

3.1.2 *hydride orientation fraction, Fn, n*—the ratio of hydride platelets oriented in the radial direction to the total hydride platelets in the field examined.

#### 3.1.3 Lot Definitions:

3.1.3.1 *castings*—a lot shall consist of all castings produced from the same pour.

3.1.3.2 *ingot*—no definition required.

3.1.3.3 *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.

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<sup>1</sup> 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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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 02.04.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.01.

<sup>4</sup> *Annual Book of ASTM Standards*, Vol 14.02.

<sup>5</sup> *Annual Book of ASTM Standards*, Vol 03.02.

<sup>6</sup> Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.