



Standard Specification for Wrought Zirconium Alloy Seamless Tubes for Nuclear Reactor Fuel Cladding¹

This standard is issued under the fixed designation B811; 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.

^{ε1} NOTE—Equations in Section A4.5 were corrected editorially in August 2014.

1. Scope

1.1 This specification covers seamless wrought zirconium-alloy tubes for nuclear fuel cladding application, in the outside diameter (OD) size range of 0.200 in. (5.1 mm) to 0.650 in. (16.5 mm) and wall thickness range of 0.010 in. (0.25 mm) to 0.035 in. (0.89 mm).

1.2 Two grades of reactor grade zirconium alloys are described.

1.2.1 The present UNS numbers designated for the two grades are given in [Table 1](#).

1.3 Unless a single unit is used, for example corrosion mass gain in mg/dm², 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:²

[B350/B350M Specification for Zirconium and Zirconium Alloy Ingots for Nuclear Application](#)
[B353 Specification for Wrought Zirconium and Zirconium Alloy Seamless and Welded Tubes for Nuclear Service](#)

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.

(Except Nuclear Fuel Cladding)

[E8 Test Methods for Tension Testing of Metallic Materials](#)
[E8M Test Methods for Tension Testing of Metallic Materials \[Metric\] \(Withdrawn 2008\)](#)³

[E21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials](#)

[E29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications](#)

[E112 Test Methods for Determining Average Grain Size](#)

[G2/G2M Test Method for Corrosion Testing of Products of Zirconium, Hafnium, and Their Alloys in Water at 680°F \(360°C\) or in Steam at 750°F \(400°C\)](#)

2.2 Other Document:

[ANSI B46.1 Surface Texture \(Surface Roughness\)](#)⁴

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 size, n*—a lot shall consist of all tubes of the same size, shape, condition, and finish produced from the same ingot by the same reduction schedule and heat treatment. The final heat treatment shall be in a single furnace charge.

3.1.4 *mill finish tubes, n*—tubes that have received all finishing operations subsequent to final anneal, which potentially affects tube mechanical, dimensional, or surface condition. These operations include, but are not limited to, pickling, cleaning, outer and inner surface abrasive conditioning, and straightening.

³ The last approved version of this historical standard is referenced on www.astm.org.

⁴ Available from American Iron and Steel Institute (AISI), 1140 Connecticut Ave., NW, Suite 705, Washington, DC 20036, <http://www.steel.org>.