



Standard Specification for Wrought Zirconium and Zirconium Alloy Seamless and Welded Tubes for Nuclear Service (Except Nuclear Fuel Cladding)¹

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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 1.

1.3 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.

1.4 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 Application²

B 811 Specification for Wrought Zirconium Alloy Seamless Tubes for Nuclear Reactor Fuel Cladding²

E 8 Test Methods for Tension Testing of Metallic Materials³

E 21 Test Methods for Elevated Temperature Tension Tests of Metallic Materials³

E 29 Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications⁴

**TABLE 1 ASTM and UNS Number Designations for
Reactor Grade Zirconium and Zirconium Alloys**

Grade	UNS Number
Reactor-grade zirconium	R60001
Zirconium-tin alloy	R60802
Zirconium-tin alloy	R60804
Zirconium-niobium alloy	R60901
Zirconium-niobium alloy	R60904

E 112 Test Methods for Determining the Average Grain Size³

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°F⁵

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]⁵

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

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 Annual Book of ASTM Standards, Vol 02.04.

³ Annual Book of ASTM Standards, Vol 03.01.

⁴ Annual Book of ASTM Standards, Vol 14.02.

⁵ Annual Book of ASTM Standards, Vol 03.02.