



Designation: **B349/B349M—09 B349/B349M – 16**

## Standard Specification for Zirconium Sponge and Other Forms of Virgin Metal for Nuclear Application<sup>1</sup>

This standard is issued under the fixed designation B349/B349M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

### 1. Scope

1.1 This specification covers one grade of virgin zirconium metal commonly designated as sponge because of its porous, sponge-like texture, but it may also take other forms such as chunklets, suitable for use in nuclear applications.

1.2 Unless a single unit is used, for example corrosion mass gain in  $\text{mg}/\text{dm}^2$ , 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 *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:*<sup>2</sup>

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

### 3. Terminology

3.1 *Forms:*

3.1.1 *chunklets, n*—zirconium metal produced from the reduction of the chloride, usually by sodium.

<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> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the [standard's Document Summary](#) page on the ASTM website.

#### 3.1.1.1 Discussion—

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

3.1.2 *sponge, n*—zirconium metal produced from the reduction of the chloride, usually by magnesium.

#### 3.1.2.1 Discussion—

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

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

### 4. Classification

4.1 Primary zirconium is furnished in one grade designated as Reactor Grade R60001, suitable for nuclear applications. The main characteristic of the reactor grade is its low neutron capture cross section as achieved by removal of hafnium. The manufacturer must use procedures to prevent contamination with other high cross-section materials.



## 5. Ordering Information

5.1 Purchase orders for material under this specification shall include the following information, as required, to describe adequately the desired material:

- 5.1.1 Quantity (weight),
- 5.1.2 Name of material (zirconium sponge or chunklets),
- 5.1.3 Grade designation (see 4.1),
- 5.1.4 ASTM designation and year of issue.

5.2 In addition to the data specified in 5.1, the following options and points of agreement between the manufacturer and the purchaser shall be specified in the purchase order, as required.

- 5.2.1 Sampling and duplicate samples (see 8.18.2 and 8.28.3).
- 5.2.2 Certification reports (Section 14), and
- 5.2.3 Packaging (Section 16).

NOTE 1—A typical ordering description is as follows: 5000 lb (2000 kg) reactor grade zirconium, Grade R60001, ASTM Specification B349/B349M - 09.

## 6. Materials and Manufacture

6.1 Zirconium metal is usually prepared by reduction of zirconium tetrachloride, and 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 material 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 zirconium metal supplied under this specification shall conform to the requirements for chemical composition prescribed in Table 1.

## 8. Sampling

8.1 This sampling method detailed in this section shall be considered the industry standard, but alternate methods are acceptable when agreed to by the manufacturer and the purchaser. All sampling methods shall be such that the analysis is representative of the sponge blend.

8.2 A blend of sponge shall be sampled by running a full quantity through a proportioner or splitter to obtain a representative sample of at least 1 % of the blend weight. The samples for chemical analyses shall be made on a compacted briquette and an evaluation ingot. The method for splitting this sample and preparing an evaluation ingot and compacted briquette shall be agreed upon between the manufacturer and the purchaser.

8.2.1 The evaluation ingot shall be greater than 30 lb (14 kg).

8.2.2 The compacted briquette shall be at least 1 lb (0.5 kg).

**TABLE 1 Chemical Requirements of Zirconium Sponge,  
Reactor Grade R60001**

Element	Permissible Impurities, max, ppm
Aluminum	75
Boron	0.5
Cadmium	0.5
Carbon	250
Chlorine	1300
Chromium	200
Cobalt	20
Copper	30
Hafnium	100
Iron	1500
Manganese	50
Molybdenum	50
Nickel	70
Nitrogen	50
Oxygen	1400
Silicon	120
Titanium	50
Tungsten	50
Uranium (total)	3.0

Note 2 — Magnesium or Sodium need to be tested only when they are used in the reduction step.