



Designation: C1098 – 08

## Standard Specification for Nuclear-Grade Hafnium Oxide Powder<sup>1</sup>

This standard is issued under the fixed designation C1098; 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.

### 1. Scope

1.1 This specification defines the physical and chemical requirements for hafnium oxide powder intended for fabrication into shapes for use in a nuclear reactor core.

1.2 The material described herein shall be particulate in nature.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

### 2. Referenced Documents

2.1 *ASTM Standards*:<sup>2</sup>

**C117** Test Method for Materials Finer than 75- $\mu\text{m}$  (No. 200) Sieve in Mineral Aggregates by Washing

**C371** Test Method for Wire-Cloth Sieve Analysis of Non-plastic Ceramic Powders

**C859** Terminology Relating to Nuclear Materials

**E11** Specification for Woven Wire Test Sieve Cloth and Test Sieves

**E105** Practice for Probability Sampling of Materials

2.2 *ANSI/ASME Standard*:

**NQA-1** ASME Quality Assurance Program Requirements for Nuclear Facility Applications<sup>3</sup>

2.3 *U.S. Government Standard*:

**Code of Federal Regulations, Title 10, Part 50, Energy (10 CFR 50), Domestic Licensing of Production and Utilization Facilities**<sup>4</sup>

### 3. Terminology

3.1 Terms shall be defined in accordance with Terminology **C859** except for the following:

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.03 on Neutron Absorber Materials Specifications.

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<sup>2</sup> 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.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.

<sup>4</sup> Available from U.S. Government Printing Office Superintendent of Documents, 732 N. Capitol St., NW, Mail Stop: SDE, Washington, DC 20401, http://www.access.gpo.gov.

3.2 *buyer*—the organization issuing the purchase order.

3.3 *hafnium oxide powder*—hafnium oxide that contains no hard aggregates larger than 20 mesh (840  $\mu\text{m}$ ).

3.4 *phase transformation*—the rearrangement of the atomic ordering of a crystalline lattice as material is cycled through a critical transformation or inversion temperature; the change from one crystalline phase to another may be accompanied by a volume change that could lead to cracks or defects in products fabricated from such materials.<sup>5,6</sup>

3.5 *powder lot*—a specified quantity of hafnium oxide powder (with stabilizing additive, if applicable) blended together such that samples taken in accordance with the procedures of Section 8 can be considered as representative of the entire quantity.

3.6 *seller*—the hafnium oxide powder processor.

3.7 *stabilizing additive*—material which, when added in sufficient concentration to the subject material exhibiting the phase transformation, produces a stabilized crystalline phase that does not undergo a transformation at any temperature within the expected fabrication or usage regime of the manufactured product; the potentially deleterious volume change is therefore avoided.

### 4. Ordering Information

4.1 The buyer shall specify the following information on the order:

4.1.1 Quantity (weight of delivered product).

4.1.2 Nominal particle size, particle size range, and applicable tolerances. Test Method **C371** and Test Method **C117** and Specification **E11** may be applied for particles larger than 37  $\mu\text{m}$ . For particle sizes less than 37  $\mu\text{m}$ , the particle size distribution will be determined using a method agreed upon between the buyer and the seller.

4.1.3 *Stabilizing Additive*—The amount and types of stabilizing additives (if any, including limits).

4.1.4 Lot size.

<sup>5</sup> Curtis, C. E., Doney, L. M., and Johnson, J. R., "Some Properties of Hafnium Oxide, Hafnium Silicate, Calcium Hafnate, and Hafnium Carbide," *Journal of American Ceramic Society*, Vol 37, 1954, pp. 458–465.

<sup>6</sup> Brown, L. M., and Mazdiyasi, K. S., "Characterization of Alkoxy-Derived Yttria-Stabilized Hafnia," *Journal of American Ceramic Society*, Vol 53, 1970, pp. 590–594.