



Designation: C1098 – 08 (Reapproved 2022)

Standard Specification for Nuclear-Grade Hafnium Oxide Powder¹

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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

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.

1.4 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*²

C117 Test Method for Materials Finer than 75- μ 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 Guide for Probability Sampling of Materials

2.2 *ANSI/ASME Standard:*

NQA-1 ASME Quality Assurance Program Requirements for Nuclear Facility Applications³

¹ 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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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.

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

2.3 *U.S. Government Standard:*

Code of Federal Regulations, Title 10, Part 50, Energy (10 CFR 50), Domestic Licensing of Production and Utilization Facilities⁴

3. Terminology

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

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 μ 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.^{5,6}

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 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>.

⁵ 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.

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