Designation: C1076 – 09 (Reapproved 2022)

Standard Specification for Nuclear Grade Hafnium Oxide Pellets[1]

This standard is issued under the fixed designation C1076; 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 applies to pellets of stabilized cubic hafnium oxide used in nuclear reactors.

1.2 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.3 *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]

C559 Test Method for Bulk Density by Physical Measurements of Manufactured Carbon and Graphite Articles

C859 Terminology Relating to Nuclear Materials

C1098 Specification for Nuclear-Grade Hafnium Oxide Powder

E105 Guide for Probability Sampling of Materials

2.2 *ANSI Standard:*[3]

ANSI/ASME NQA-1 Quality Assurance Requirements for Nuclear Facility Applications

2.3 *U.S. Government Document:*[4]

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

3. Terminology

3.1 *Definitions:*

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

3.1.2 *buyer*—organization issuing the purchase order.

3.1.3 *pellet*—fabricated geometric shape of stabilized cubic hafnium oxide having a chemical composition as described in Section 4.

3.1.4 *pellet lot*—the pellets produced from one hafnium oxide powder lot using one set of process parameters. Pellet lot size shall be agreed upon between the seller and the buyer.

3.1.5 *phase transformation*—rearrangement of the atomic ordering of a crystalline lattice as a 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 articles fabricated from such materials.[5,6]

3.1.6 *powder lot*—a specified quantity of hafnium oxide powder with stabilizing additive, blended together such that samples taken in accordance with Section 7 can be considered as representative of the entire quantity.

3.1.7 *seller*—hafnium oxide pellet supplier.

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

4. Chemical Composition

4.1 The starting hafnium oxide powder shall be in accordance with Specification C1098.

4.2 A stabilizing additive shall be utilized with the hafnium oxide. The recommended stabilizing additive is yttrium oxide

[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 Sevice 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.

[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 Ceramics Society*, Vol 37, 1954, pp. 458–465.

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