



Standard Specification for Nuclear Grade Zirconium Oxide Pellets¹

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1. Scope

1.1 This specification applies to pellets of stabilized zirconium 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.

2. Referenced Documents

2.1 ASTM Standards:²

C 559 Test Method for Bulk Density by Physical Measurements of Manufactured Carbon and Graphite Articles

C 859 Terminology Relating to Nuclear Materials

C 1065 Specification for Nuclear Grade Zirconium Oxide Powder

E 105 Practice for Probability Sampling of Materials

2.2 ANSI Standard:

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

2.3 U.S. Government Document:

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 C 859, except for the following:

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

3.1.2 *pellet*—a fabricated geometric shape of zirconium oxide having a chemical composition as described in Section 4.

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

3.1.4 *phase transformation*—the 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.

3.1.5 *powder lot*—a specified quantity of zirconium-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.

3.1.6 *seller*—the zirconium oxide pellet supplier.

3.1.7 *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 zirconium oxide powder shall be in accordance with Specification C 1065.

4.2 A stabilizing additive shall be used with the zirconium oxide. The recommended stabilizing additive is either calcium oxide (CaO) or yttrium oxide (Y₂O₃). The recommended additive concentration in the case of CaO stabilization is 4 to 8 weight %. In the case of Y₂O₃ stabilization, the recommended additive concentration is 14 to 20 weight %.

4.3 Use analytical chemistry methods as agreed upon between the buyer and seller.

4.4 The impurity concentration excluding the stabilizing additives, shall not exceed 0.5 weight %. Individual element limits are specified in Table 1. The buyer may specify additional limits for any other elements not listed in Table 1.

4.5 The moisture concentration is included in the total hydrogen limit (see Table 1).

5. Physical Requirements

5.1 Physical Dimensions:

5.1.1 Dimensional requirements shall be in accordance with applicable drawings and purchase order documents.

¹ This specification is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C 26.03 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, 11 W. 42nd St., 13th Floor, New York, NY 10036.

⁴ Available from U.S. Government Printing Office, Washington, DC 20402.