



Designation: C888-03 Designation: C 888 – 03 (Reapproved 2008)

Standard Specification for Nuclear-Grade Gadolinium Oxide (Gd₂O₃) Powder¹

This standard is issued under the fixed designation C 888; 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 provides the chemical and physical requirements for nuclear-grade gadolinium oxide powder intended for subsequent processing and use in nuclear fuel applications, for example, as an addition to uranium dioxide.

1.2 This specification does not include requirements for health and safety. Observance of this specification does not relieve the user of the obligation to be aware of and comply with all federal, state, and local regulations pertaining to possessing, shipping, processing, or using this material.

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:²

B 329 Test Method for Apparent Density of Metal Powders of Refractory Metals and Compounds by Using the Scott Volumeter

C 493 Test Method for Bulk Density and Porosity of Granular Refractory Materials by Mercury Displacement (Discontinued 2002)

C 859 Terminology Relating to Nuclear Materials

C 889 Test Methods for Chemical and Mass Spectrographic Spectrometric Analysis of Nuclear-Grade Gadolinium Oxide (Gd₂O₃) Powder

E 11 Specification for Wire Cloth Sieves for Testing Purposes Specification for Wire Cloth and Sieves for Testing Purposes

E 105 Practice for Probability Sampling of Materials

2.2 ANSI Standard:

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

2.3 U.S. Government Document:

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

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 Terms shall be defined in accordance with Terminology C 859 except as defined herein.

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

3.1.1.2 *powder lot*—a quantity of gadolinium oxide powder that has been processed in a manner such that samples taken in accordance with the procedures of 8.1 can be considered as representative of the entire powder lot.

3.1.1.3 *seller*—the gadolinium oxide powder supplier.

4. Ordering Information

4.1 The buyer shall specify the following information for all orders where this specification applies:

4.1.1 Powder lot size (allowable range),

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.

Current edition approved Feb. 10, 2003. Published February 2003. Originally approved in 1978. Last previous edition approved in 1997 as C888-97.

Current edition approved Dec. 1, 2008. Published January 2009. Originally approved in 1978. Last previous edition approved in 2003 as C 888 – 03.

² Annual Book of ASTM Standards, Vol 02.05.

³ 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.

⁴ Annual Book of ASTM Standards, Vol 15.01.

⁵ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

⁶ Annual Book of ASTM Standards, Vol 12.01.

⁷ 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>.

- 4.1.2 Quantity (weight of delivered product),
- 4.1.3 Nominal particle size range and applicable tolerances in accordance with Specification E 11,
- 4.1.4 Density (optional), Scott Volumeter (Test Method B 329) and Mercury Displacement (Test Method C 493) are referenced as guides to density measurement techniques,
- 4.1.5 Shape factor and method of determination (optional),
- 4.1.6 Sampling requirements,
- 4.1.7 Crystal structure (optional), and
- 4.1.8 Quality requirements.

5. Chemical Composition

5.1 *Loss-on-Ignition*— The loss-on-ignition as determined after ignition for 2 h at a minimum temperature of 900°C shall not exceed 1.5 weight %.

5.2 *Gadolinium Oxide Concentration* —The minimum Gd₂O₃ concentration shall be 99.8 weight % exclusive of the constituents lost on ignition as determined by Test Methods C 889.

5.2.1 *Gadolinium Oxide Isotope Concentration* —The isotopic concentration of the gadolinium shall be that which is found in naturally occurring gadolinium for the following isotopes:

Isotope	Atomic %
¹⁵⁵ Gd	14.9 ± 1.0
¹⁵⁷ Gd	15.7 ± 1.0

5.3 *Impurity Content:*

5.3.1 *Individual Impurity Limits* —Individual impurities exclusive of constituents lost on ignition shall not exceed the following limits—limits:

Element	Maximum Concentration (µg/g Gd ₂ O ₃)
Boron	5
Cadmium	25
Thorium	30
(Chlorine + fluorine)	100
(Europium + samarium + terbium + ytterbium + dysprosium)	1000
Carbon	600

5.3.2 The buyer may specify individual impurity limits for any elements not listed in 5.3.1. Any identified impurity exceeding 1000 µg/g Gd₂O₃ shall be reported. The total of all measured impurities shall not exceed 2000 µg/g Gd₂O₃.

6. Physical Properties

6.1 Physical properties listed in 4.1.3, 4.1.4, 4.1.5, and 4.1.7 shall be in compliance with the buyer's requirements.

7. Cleanliness

7.1 The lot shall be processed and packaged in a manner that precludes contamination by dust, organics, plastics, or other foreign materials.

8. Sampling

8.1 Sampling plans to meet acceptance criteria and inspection and measurement procedures that describe the method of compliance with this specification shall be approved by the buyer. The degree of sampling where not specified in this document varies with the application and therefore should be specified on the purchase order. Recommended Practice E 105 is referenced as a guide.

8.2 Each sample taken shall be sufficient to perform the following in the event they are necessary or desired by the buyer:

- 8.2.1 Quality verification tests by the seller,
- 8.2.2 Acceptance tests by the buyer,
- 8.2.3 Referee tests, in the event these become necessary, and
- 8.2.4 Retention of archive samples by the seller.

8.3 Archive samples shall be retained for a period of time specified by the buyer and delivered to the buyer upon request.

9. Inspection and Certification

9.1 The seller shall inspect the material covered by this specification and shall provide the buyer with certificates of tests showing the results of all testing and inspection performed on each lot.

9.2 The seller shall deliver all test certificates to the buyer prior to or concurrent with the shipment of the powder lot.

10. Rejection and Rehearing

10.1 Unless the buyer and seller agree otherwise, rejection and acceptance shall be on a lot basis.