



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

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## 1. Scope

1.1 This specification provides the chemical and physical requirements for nuclear-grade aluminum oxide powder intended for fabrication into shapes for nuclear applications. Two specific uses for which this powder is intended are Al<sub>2</sub>O<sub>3</sub> pellets and Al<sub>2</sub>O<sub>3</sub> – B<sub>4</sub>C composite pellets for use as thermal insulator or burnable neutron absorbers.

1.2 The material described herein shall be particulate in nature.

## 2. Referenced Documents

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

C 809 Methods for Chemical, Mass Spectrometric, and Spectrochemical Analysis of Nuclear-Grade Aluminum Oxide and Aluminum Oxide-Boron Carbide Composite Pellets

C 859 Terminology Relating to Nuclear Materials

E 105 Practice for Probability Sampling of Materials

2.2 *ANSI Standard*:

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

2.3 *U.S. Government Document*:

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

## 3. Terminology

3.1 *Descriptions of Terms Specific to This Standard*—Terms shall be defined in accordance with Terminology C 859 except for the following:

3.1.1 *buyer*—organization issuing the purchase order.

3.1.2 *powder lot*—that quantity of aluminum oxide powder made up of powder from one or more sources, blended together such that samples taken in accordance with the procedures in Section 8 can be considered as representative of the entire quantity.

3.1.3 *seller*—aluminum oxide manufacturer.

## 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 Lot size (allowable range), and

4.1.3 Sample requirements.

4.2 The particle size distribution will be determined utilizing a method agreed upon between buyer and seller.

## 5. Chemical Composition

5.1 The powder shall conform to the following chemical requirements (see Methods C 809):

Element	Weight %, max
Silicon	2.0
Iron-Chromium-Nickel	0.6
Magnesium	1.0
Sodium	0.2
Calcium	0.3
Hafnium	200 µg/g Al <sub>2</sub> O <sub>3</sub>
Fluorine	50 µg/g Al <sub>2</sub> O <sub>3</sub>
Fluorine-Chlorine-Iodine-Bromine	100 µg/g Al <sub>2</sub> O <sub>3</sub>
Gadolinium	100 µg/g Al <sub>2</sub> O <sub>3</sub>
Samarium	100 µg/g Al <sub>2</sub> O <sub>3</sub>
Europium	100 µg/g Al <sub>2</sub> O <sub>3</sub>
Dysprosium	200 µg/g Al <sub>2</sub> O <sub>3</sub>

5.2 Any identified impurity exceeding 1.0 weight % shall be reported. The total of all measured impurities shall not exceed 4.0 weight %.

NOTE 1—The buyer may specify limits for any other elements (for example, neutron absorbing materials, such as boron) not listed in 5.1.

## 6. Physical Requirements

6.1 The particle size distribution shall have a mean value of 6 µm or less. The particle size distribution will be determined utilizing a method submitted by the seller for approval by the buyer.

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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 the American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

<sup>4</sup> Available from Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

## 7. Cleanliness

7.1 The powder lot shall be handled in a manner to avoid contamination by foreign matter such as dust, cleaning agents and organics, and materials, such as plastics and paper, used in packaging. Cleaning solutions, if used, shall be free of halides or nonvolatile additives and shall be removed from the powder prior to sampling and packaging.

## 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 specification, varies with the application and for this reason should be specified on the purchase order. Practice E 105 is referenced as a guide.

8.2 Each sample taken shall be sufficient to perform the following in the event that 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 by the seller for a period of time specified by the buyer and be delivered to the buyer upon request.

## 9. Inspection and Certification

9.1 The seller shall inspect the material covered by this specification and shall furnish the buyer with certificates of tests showing the results of testing and inspection performed on each powder lot. The seller shall certify that each powder lot is in compliance with the provisions of this specification.

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## 10. Rejection and Rehearing

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

10.2 Powder lots that fail to conform to the requirements of this specification may be rejected by the buyer. The seller may petition the buyer to waive selected requirements for identified out-of-specification lots. Decision to grant such waiver belongs to the buyer. The seller may also apply any remedy to bring rejected lots into specification providing the seller can demonstrate to the buyer that such remedy does not impair the function or preclude the certification of the rejected material.

10.3 In the event of disagreement over the results of chemical analyses, samples shall be submitted to a mutually selected referee for resolution.

## 11. Packaging and Package Marking

11.1 Aluminum oxide powder shall be packaged in sealed containers to prevent loss or damage, or both, of material and contamination from airborne or container materials. The exact size and type of packaging shall be as mutually agreed upon by the buyer and the seller.

11.2 Each container shall be clearly marked with the following:

- 11.2.1 Aluminum oxide powder,
- 11.2.2 Purchase order number,
- 11.2.3 Purchase order Specification
- 11.2.4 Gross, net, and tare weight,
- 11.2.5 Lot number, and
- 11.2.6 Name of seller.

## 12. Quality Assurance

12.1 Quality assurance requirements shall be agreed upon between the buyer and the seller when specified in the purchase order. Code of Federal Regulations, Title 10, Part 50 (Appendix B) and NQA-1 are referenced as guides.