



# Standard Specification for Uranium Ore Concentrate<sup>1</sup>

This standard is issued under the fixed designation C967; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## INTRODUCTION

This specification is intended to provide the nuclear industry with a general standard for uranium ore concentrate. Material conforming to this specification will generally meet the requirements for conversion to uranium hexafluoride. However, the converter may relax or supplement this specification upon mutual agreement with the customer.

## 1. Scope

1.1 This specification covers uranium ore concentrate containing a minimum of 65 mass % uranium.

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 conform to all applicable international, national, state, and local regulations pertaining to possessing, shipping, or using source nuclear material (see 2.2).

1.3 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:<sup>2</sup>

C859 Terminology Relating to Nuclear Materials  
C1022 Test Methods for Chemical and Atomic Absorption Analysis of Uranium-Ore Concentrate  
C1075 Practices for Sampling Uranium-Ore Concentrate  
C1380 Test Method for the Determination of Uranium Content and Isotopic Composition by Isotope Dilution Mass Spectrometry

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.02 on Fuel and Fertile Material Specifications.

Current edition approved Jan. 1, 2013. Published January 2013. Originally approved in 1981. Last previous edition approved in 2012 as C967 – 12. DOI: 10.1520/C0967-13.

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

### 2.2 U.S. Government Documents:

Nuclear Materials Licensing Code of Federal Regulations, Energy Title 10, Chapter 1, Nuclear Regulatory Commission<sup>3</sup>

Nuclear Materials Licensing Code of Federal Regulations, Title 49, Transportation Chapter 1, Materials Transportation Bureau<sup>4</sup>

Nuclear Materials Licensing Code of Federal Regulations, Energy Part 50 (10CFR 50) Licensing of Domestic Production and Utilization Facilities<sup>3</sup>

### 2.3 ANSI Standard:<sup>5</sup>

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

## 3. Definitions

3.1 Except as otherwise defined herein, definitions of terms are as given in Terminology C859.

## 4. Chemical Composition

4.1 *Uranium Content*—The uranium content, as received, shall be a minimum of 65 mass %.

4.2 *Isotopic Content*—The isotopic content shall be that of naturally occurring uranium ( $0.711 \pm 0.001$  g <sup>235</sup>U per 100 g (see Note 1). The <sup>234</sup>U content shall not exceed the limits in Table 1.

<sup>3</sup> Available from the Nuclear Regulatory Commission, Washington, DC, 20555-0001, [www.nrc.gov](http://www.nrc.gov).

<sup>4</sup> Available from the Materials Transportation Bureau, 400 Seventh St., Washington, DC, 20590.

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

**TABLE 1 Impurities and Maximum Concentration Limits**

Impurity	Maximum Concentration Limit (Mass %, Uranium Basis) <sup>A</sup>	
	Limit Without Penalty <sup>B</sup>	Limit Without Rejection <sup>C</sup>
As	0.05	0.10
B	0.005	0.10
Ca	0.05	1.00
Carbonate	0.20	0.50
F	0.01	0.10
Halogens <sup>D</sup>	0.05	0.10
Fe	0.15	1.00
Mg	0.02	0.50
Moisture <sup>E</sup>	2.0	5.0
Mo	0.10	0.30
P	0.10	0.70
K	0.20	3.00
Si(calculated as SiO <sub>2</sub> )	0.50	2.50
Na	0.50	7.50
S	1.00	4.00
Th	0.10	2.50
Ti	0.01	0.05
V	0.06	0.30
Zr	0.01	0.10
<sup>234</sup> U	56 <sup>F</sup>	62 <sup>F</sup>

<sup>A</sup>Except as specified otherwise.

<sup>B</sup>Surcharges may apply to concentrate having impurities exceeding these limits.

<sup>C</sup>These limits are based on commonly used ore compositions and processing technology and can vary when agreed upon in advance among all parties.

<sup>D</sup>Exclusive of fluorine.

<sup>E</sup>As determined by the sampling facility. In case of uranium peroxide, moisture shall be understood as “free moisture”; determined by calcinations at 110°C.

<sup>F</sup>micrograms per gram of total uranium (µg/gU).

NOTE 1—For ore concentrate from verifiable source (for example, through the seller’s quality assurance records), the <sup>235</sup>U analysis is not normally required unless otherwise agreed upon between the buyer and seller.

4.3 *Insoluble Uranium*—The uranium insoluble in nitric acid shall be a maximum of 0.10 mass % on a uranium basis.

4.4 *Extractable Organic*—Depending on the conversion process (dry route vs. wet route), the need for measurement of extractable organic shall be agreed upon between buyer and seller (see **Note 2**).

NOTE 2—If a measurement is requested, a limit of 0.1 g per 100 g of ore concentrate shall be used.

4.5 *Impurity Content*—The impurity content shall be less than the maximum limits specified in **Table 1**.

4.6 *Uranium Daughters*—Long-lived radionuclides, such as <sup>231</sup>Pa, <sup>230</sup>Th, and <sup>226</sup>Ra, may concentrate in residues and therefore may impact storage and transportation of wastes. Conversion facilities should be aware that their level can vary. Determination of these elements and the analytical frequency may be agreed between buyer and seller.

## 5. Physical Properties

5.1 *Particle Size*—All of a representative sample (Section 6) shall pass through a sieve with an aperture of ¼ in.

5.2 *Ability to Flow*—Concentrate shall be sufficiently free-flowing to permit sampling.

5.3 *Foreign Matter*—Concentrate shall be free of all materials and objects that: (a) are not produced as a constituent of concentrates in the milling of uranium ore, or, (b) would or

could be detrimental to the sampling of concentrates or to the equipment used in such sampling.

## 6. Sampling

6.1 The lot size and number of tests (and retests when required) shall be as mutually agreed.

6.2 A representative sample, of a size sufficient to perform the tests prescribed in Sections 4 and 5, shall be taken from each lot.

6.3 Practices **C1075** is referenced as a guide.

## 7. Test Methods

7.1 All chemical analyses shall be performed on portions of the representative sample prepared in accordance with Section 6. Analytical chemistry methods shall be in accordance with Test Methods **C1022**, **C1380** or as otherwise agreed.

## 8. Certification

8.1 When specified in the purchase order or contract, certification shall be furnished that the material was sampled and tested in accordance with this specification and has been found to meet the requirements. When specified in the purchase order or contract, a report of the test results shall be furnished.

## 9. Packaging and Package Marking

9.1 Uranium ore concentrate shall be packaged and shipped in drums having lids fitted with watertight sealing rings. The lids shall be attached to the drums in a manner that minimizes

loss of concentrate in the event of mishandling. Shipping containers shall meet applicable regulatory requirements. CFR Title 10 and Title 49 are referenced as guides.

9.2 Each container shall bear, as a minimum, labels on the lid and side with the following information:

- 9.2.1 Seller's name,
- 9.2.2 Material in containers,
- 9.2.3 Lot number,
- 9.2.4 Gross, tare and net weights, and
- 9.2.5 Container ( ) of ( ).

9.3 Uranium Ore Concentrate suppliers should be aware that decomposition of peroxides can lead to pressurization of transport containers. Such condition may be noncompliant with transport regulations.

## **10. Quality Assurance**

10.1 Quality assurance requirements shall be as 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 ANSI/ASME NQA-1 are referenced as guides.

## **11. Keywords**

- 11.1 concentrates; uranium ore; yellow cake

*ASTM International takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.*

*This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the ASTM website (www.astm.org/COPYRIGHT/).*