



Standard Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry¹

This standard is issued under the fixed designation C 1000; 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 test method covers the determination of uranium isotopes in soil. This test method describes one acceptable approach to the determination of uranium isotopes in soil.²

1.2 The test method is designed to analyze 10 g of soil; however, the sample size may be varied to 50 g depending on the activity level. This test method may not be able to completely dissolve all forms of uranium in the soil matrix.

1.3 The lower limit of detection is dependent on count time, sample size, detector efficiency, background, and tracer yield. The chemical recovery averaged 78 % in a single laboratory evaluation, and 66 % in an interlaboratory collaborative study.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.* A specific precautionary statement is given in Section 10.

2. Referenced Documents

2.1 ASTM Standards:

C 998 Practice for Sampling Surface Soil for Radionuclides³

C 999 Practice for Soil Sample Preparation for the Determination of Radionuclides³

C 1163 Test Method for Mounting Actinides for Alpha Spectrometry Using Neodymium Fluoride³

D 1193 Specification for Reagent Water⁴

D 3084 Practice for Alpha-Particle Spectrometry of Water⁵

D 3648 Practices for the Measurement of Radioactivity⁵

IEEE/ASTM SI-10 Standard for the Use of the International System of Units (SI): The Modern Metric System⁶

3. Summary of Test Method

3.1 A soil sample with uranium-232 tracer added is heated to destroy organic matter and dissolved with a mixture of hydrofluoric acid and nitric acid. The uranium is coprecipitated with ferric hydroxide and the precipitate is dissolved with hydrochloric acid. Iron is removed by extraction with isopropyl ether, and plutonium, radium, and thorium are separated from uranium by anion exchange. Uranium is electrodeposited on a stainless steel disk and determined by alpha spectrometry. As an option, the uranium may be prepared for alpha spectrometric measurement by using coprecipitation with neodymium fluoride.

4. Significance and Use

4.1 This test method is used to analyze soil for uranium isotopes. It can be used to establish baseline uranium levels and to monitor depositions from nuclear facilities.

5. Interferences

5.1 Protactinium-231 may not be completely separated by the procedure and could interfere with the determination of uranium-233 or uranium-234 because it has the following alpha energies in MeV: 5.06, 5.03, 5.01, 4.95 and 4.73 (see Appendix).

6. Apparatus

6.1 Alpha Pulse Height Analysis System:²

6.1.1 A system consisting of a charged particle detector capable of 50 keV or less resolution on samples electrodeposited on a flat mirror-finished stainless steel disk is required.

6.1.2 The resolution is defined as the width of an alpha peak when the counts on either side of the peak are equal to one-half of the counts at the maximum of the peak (full width at half maximum height (FWHM)).

6.1.3 The counting efficiency of the system should be greater than 15 % and the background in the energy region of each peak should be less than 10 counts in 1,000 min.

6.1.4 A regular program of measurement control operations should be conducted for the alpha spectrometry system such as regular background checks, daily source check to determine system stability, control charting, and careful handling of samples during changing.

6.2 Electrodeposition Apparatus²—A direct current power

¹ This test method is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.05 on Test Methods.

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² Casella, V. A., Bishop, C. T., and Glosby, A. A., "Radiometric Method for the Determination of Uranium in Soil and Air," U.S. Environmental Protection Agency, EPA-600/7-80-019, Las Vegas, NV, February 1980.

³ *Annual Book of ASTM Standards*, Vol 12.01.

⁴ *Annual Book of ASTM Standards*, Vol 11.01.

⁵ *Annual Book of ASTM Standards*, Vol 11.02.

⁶ *Annual Book of ASTM Standards*, Vol 14.04.