



Standard Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy¹

This standard is issued under the fixed designation C1001; 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 plutonium in soils at levels of detection dependent on count time, sample size, detector, background, and tracer yield. This test method describes one acceptable approach to the determination of plutonium in soil.

1.2 This test method is designed for 10 g of soil, previously collected and treated as described in Practices C998 and C999, but sample sizes up to 50 g may be analyzed by this test method. This test method may not be able to completely dissolve all forms of plutonium in the soil matrix.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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.* Specific hazard statements are given in Section 9.

2. Referenced Documents

2.1 ASTM Standards:²

C859 Terminology Relating to Nuclear Materials

C998 Practice for Sampling Surface Soil for Radionuclides

C999 Practice for Soil Sample Preparation for the Determination of Radionuclides

C1163 Practice for Mounting Actinides for Alpha Spectrometry Using Neodymium Fluoride

C1284 Practice for Electrodeposition of the Actinides for Alpha Spectrometry

D1193 Specification for Reagent Water

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 Methods of Test.

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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.

D3084 Practice for Alpha-Particle Spectrometry of Water

D3648 Practices for the Measurement of Radioactivity

D7282 Practice for Set-up, Calibration, and Quality Control of Instruments Used for Radioactivity Measurements

3. Summary of Test Method

3.1 Plutonium is extracted from the soil with a mixture of nitric, hydrofluoric, and hydrochloric acids in the presence of ²⁴²Pu or ²³⁶Pu isotopic tracer (See Appendix for purification and standardization of ²³⁶Pu tracer). Plutonium is isolated by anion exchange, then electrodeposited onto a polished metal disk for determination by alpha spectrometry. As an option, the plutonium may be prepared for alpha spectrometry measurement by using coprecipitation with neodymium fluoride. The range of chemical yield is between 40 and 90 %. The test method is based on a published procedure (1).³

4. Significance and Use

4.1 A soil sampling and analysis program provides a direct means of determining the concentration and distribution of radionuclides in soil. A soil analysis program has the most significance for the preoperational monitoring program to establish baseline concentrations prior to the operation of a nuclear facility. Soil analysis, although useful in special cases involving unexpected releases, is a poor technique for assessing small incremental releases and is therefore not recommended as a method for routine monitoring releases of radioactive material. Nevertheless, because soil is an integrator and a reservoir of long-lived radionuclides, and serves as an intermediary in several of the plutonium pathways of potential importance to humans, knowledge of the concentration of plutonium in soil is essential.

5. Apparatus

5.1 *Electrodeposition Apparatus* (2), see Practice C1284.

5.2 *Alpha Spectrometer*, capable of 40 to 50 keV resolution on actual samples electrodeposited on a flat, mirror-finished metal planchet, and a fractional counting efficiency greater than 17 %, and a background less than 0.010 cpm over each

³ The boldface numbers in parentheses refer to the list of references at the end of this standard.