



Standard Guide for Determination of Neptunium-237 in Soil¹

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1. Scope

1.1 This guide covers the determination of neptunium-237 in soil by means of radiochemical separations and alpha spectrometry. This guide provides options in the selection of sample preparation, separation, and measurement. Although neptunium-237 is not a component of global fallout, it is a product of production reactors and spent fuel processing. This guide is designed for analysis of ten grams of soil previously collected and treated in accordance with Practices C 998 and C 999. Larger-size samples of environmental soil may also be analyzed, as long as the concentrations of interferences such as uranium and thorium are at or near environmental concentrations. Depending on the choice of a sample dissolution method, all chemical forms of neptunium may not be completely solubilized. This guide should allow the determination of neptunium-237 concentrations from sub becquerel per gram levels to applicable standards depending on count time, sample size, detector efficiency, background, and tracer yield.

1.2 *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 limitations prior to use.* Specific precautionary statements are given in Section 8.

2. Referenced Documents

2.1 ASTM Standards:

- C 998 Practice for Sampling Surface Soil for Radionuclides²
- C 999 Practice for Soil Sample Preparation for the Determination of Radionuclides²
- C 1000 Test Method for Radiochemical Determination of Uranium Isotopes in Soil by Alpha Spectrometry²
- C 1001 Test Method for Radiochemical Determination of Plutonium in Soil by Alpha Spectroscopy²
- C 1163 Test Method for Mounting Actinides for Alpha Spectrometry Using Neodymium Fluoride²
- C 1284 Practice for Electrodeposition of the Actinides for Alpha Spectrometry²
- C 1317 Practice for Dissolution of Silicate or Acid-

Resistant Matrix Samples²

- C 1342 Practice for Flux Fusion Sample Dissolution²
- C 1387 Guide for Determination of Technetium-99 in Soil²
- C 1412 Practice for Microwave Oven Dissolution of Glass Containing Radioactive and Mixed Wastes²
- D 1193 Specification for Reagent Water³
- D 1890 Test Method for Beta Particle Radioactivity of Water⁴
- D 3084 Practice for Alpha-Particle Spectrometry of Water⁴
- D 4962 Practice for NaI(Tl) Gamma-Ray Spectrometry of Water⁴
- IEEE/ASTM SI-10 Standard for the Use of the International System of Units (SI): The Modern Metric System⁵

3. Summary of Guide

3.1 This guide may be used to determine neptunium-237 in soil at potential release sites. A neptunium-239 yield monitor is added to the soil aliquot and the sample solubilized by one of several methods, such as those described in Guide C 1387. The neptunium is separated from the resulting solution using an extraction chromatography column. A valence adjustment is performed prior to loading the sample onto the conditioned chromatography column. The sample is passed through the column, which retains the neptunium in the +4 oxidation state. The column is washed to remove interferences and selectively eluted with dilute acid. The samples are prepared for measurement by neodymium fluoride co-precipitation or electrodeposition, and the neptunium-237 content determined by alpha spectrometry. The neptunium-239 yield monitor is determined by beta or gamma-ray counting.

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. The presence and extent of neptunium-237 is of particular interest because it is one of the more mobile transuranics in terms of migration and plant uptake. Since soil is an integrator and a reservoir on long-lived radionuclides, and serves as an intermediary in several pathways of potential importance to humans, knowledge of the concentration of neptunium-237 in soil is essential.

¹ This guide 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. Current edition approved June 10, 2000. Published August 2000.

² Annual Book of ASTM Standards, Vol 12.01.

³ Annual Book of ASTM Standards, Vol 11.01.

⁴ Annual Book of ASTM Standards, Vol 11.02.

⁵ Annual Book of ASTM Standards, Vol 14.04.

