



# Standard Test Method for Analysis of Total and Isotopic Uranium and Total Thorium in Soils by Inductively Coupled Plasma-Mass Spectrometry<sup>1</sup>

This standard is issued under the fixed designation C1345; 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.

## 1. Scope

1.1 This test method covers the measurement of total uranium (U) and thorium (Th) concentrations in soils, as well as the determination of the isotopic weight percentages of  $^{234}\text{U}$ ,  $^{235}\text{U}$ ,  $^{236}\text{U}$ , and  $^{238}\text{U}$ , thereby allowing for the calculation of individual isotopic uranium activity or total uranium activity. This inductively coupled plasma-mass spectroscopy (ICP-MS) method is intended as an alternative analysis to methods such as alpha spectroscopy or thermal ionization mass spectroscopy (TIMS). Also, while this test method covers only those isotopes listed above, the instrumental technique may be expanded to cover other long-lived radioisotopes since the preparation technique includes the preconcentration of the actinide series of elements. The resultant sample volume can be further reduced for introduction into the ICP-MS via an electrothermal vaporization (ETV) unit or other sample introduction device, even though the standard peristaltic pump introduction is applied for this test method. The sample preparation removes organics and silica from the soil by use of a high temperature furnace and hydrofluoric acid digestion. Thus, this test method can allow for sample variability of both organic and silica content. This test method is also described in ASTM STP 1291. Since this test method using quadrupole ICP-MS was approved, advances have been made in ICP-MS technology in terms of improved sensitivity and lower instrument background as well as the use of collision or reaction cells (or both) and sector field mass spectrometers with single and multiple detectors. These advances should allow this test method to be performed more effectively but it is the user's responsibility to verify performance.

1.2 The analysis is performed after an initial drying and grinding sample preparation process, and the results are reported on a dry weight basis. The sample preparation technique used incorporates into the sample any rocks and organic material present in the soil. The method of sample preparation

applied differs from other techniques, such as those found in Practice C999, which involve simply tumbling and sieving the sample; however, the user may select whichever technique is most appropriate to their needs.

1.3 The values stated in SI units are to be regarded as standard.

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.*

## 2. Referenced Documents

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

- 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
- C1255 Test Method for Analysis of Uranium and Thorium in Soils by Energy Dispersive X-Ray Fluorescence Spectroscopy
- D420 Guide to Site Characterization for Engineering Design and Construction Purposes (Withdrawn 2011)<sup>3</sup>
- D1193 Specification for Reagent Water
- D1452 Practice for Soil Exploration and Sampling by Auger Borings
- D1586 Test Method for Penetration Test (SPT) and Split-Barrel Sampling of Soils
- D1587 Practice for Thin-Walled Tube Sampling of Soils for Geotechnical Purposes
- D2113 Practice for Rock Core Drilling and Sampling of Rock for Site Exploration
- D2216 Test Methods for Laboratory Determination of Water (Moisture) Content of Soil and Rock by Mass
- D3550 Practice for Thick Wall, Ring-Lined, Split Barrel, Drive Sampling of Soils

<sup>1</sup> 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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<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.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).