



Standard Test Method for Uranium in Drinking Water by High-Resolution Alpha-Liquid-Scintillation Spectrometry¹

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1. Scope

1.1 This test method covers determining the total soluble uranium activity in drinking water in the range of 0.037 Bq/L (1 pCi/L) or greater by selective solvent extraction and high-resolution alpha-liquid-scintillation spectrometry. The energy resolution obtainable with this technique also allows estimation of the ^{238}U to ^{234}U activity ratio.

1.2 This test method was tested successfully with reagent water and drinking water. It is the user's responsibility to ensure the validity of this test method for waters of untested matrices.

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.* For specific hazard statements, see Section 9.

2. Referenced Documents

2.1 ASTM Standards:²

D1129 Terminology Relating to Water

D1193 Specification for Reagent Water

D2777 Practice for Determination of Precision and Bias of Applicable Test Methods of Committee D19 on Water

D3370 Practices for Sampling Water from Closed Conduits

D3648 Practices for the Measurement of Radioactivity

D5847 Practice for Writing Quality Control Specifications for Standard Test Methods for Water Analysis

¹ This test method is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.04 on Methods of Radiochemical Analysis.

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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.

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

3. Terminology

3.1 Definitions:

3.1.1 For definitions of terms used in this test method, refer to Terminology D1129. For terms not included in this reference, refer to other published glossaries (1).³

4. Summary of Test Method

4.1 This test method is based on solvent extraction technology to isolate and concentrate uranium in drinking water for counting via a high-resolution alpha-liquid-scintillation spectrometer.

4.2 To determine total uranium, as well as limited isotopic uranium (^{238}U and ^{234}U) by activity in drinking water, a 200-mL acidified water sample is first spiked with ^{232}U as an isotopic tracer, boiled briefly to remove radon, and evaporated until less than 50 mL remain. The solution is then made approximately 0.01 M in diethylenetriaminepentaacetic acid (DTPA) and the pH is adjusted to between 2.5 and 3.0. The sample is transferred to a separatory funnel and equilibrated with 1.50 mL of an extractive scintillator containing a dialkyl phosphoric acid extracting agent. Under these conditions only uranium is quantitatively transferred to the organic phase while the extraction of undesired ions is masked by the presence of DTPA. Following phase separation, 1.00 mL of the organic phase is sparged with dry argon gas to remove oxygen, a chemical quench agent, and counted on a high-resolution alpha-liquid-scintillation spectrometer and multichannel analyzer (MCA).

4.3 The alpha spectrum of a sample that contains natural uranium and that is analyzed with an internal ^{232}U tracer will appear similar to the spectrum in Fig. 1. An approximate resolution of 250 keV FWHM for ^{238}U (4.2 MeV) allows resolution and analysis of the ^{238}U , ^{234}U , and ^{232}U energy spectrum peaks when their activities are of the same order of magnitude. Resolution of the ^{235}U (4.4 MeV) alpha peak is not possible, but its activity, which accounts for approximately

³ The boldface numbers in parenthesis refer to the list of references at the end of the text.