



Standard Test Method for Alpha-Particle-Emitting Isotopes of Radium in Water¹

This standard is issued under the fixed designation D2460; 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 separation of dissolved radium from water for the purpose of measuring its radioactivity. Although all radium isotopes are separated, the test method is limited to alpha-particle-emitting isotopes by choice of radiation detector. The most important of these radioisotopes are ²²³Ra, ²²⁴Ra, and ²²⁶Ra. The lower limit of concentration to which this test method is applicable is 3.7×10^{-2} Bq/L (1 pCi/L).

1.2 This test method may be used for absolute measurements by calibrating with a suitable alpha-emitting radioisotope such as ²²⁶Ra, or for relative methods by comparing measurements with each other. Mixtures of radium isotopes may be reported as equivalent ²²⁶Ra. Information is also provided from which the relative contributions of radium isotopes may be calculated.

1.3 *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 a specific precautionary statement, see Section 9.

2. Referenced Documents

2.1 ASTM Standards:²

- C859 Terminology Relating to Nuclear Materials
- D1129 Terminology Relating to Water
- D1193 Specification for Reagent Water
- D1943 Test Method for Alpha Particle Radioactivity of 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

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.

Current edition approved Jan. 1, 2013. Published January 2013. Originally approved in 1966. Replaces D2460–66 T. Last previous edition approved in 2007 as D2460 – 07. DOI: 10.1520/D2460-07R13.

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.

- D3454 Test Method for Radium-226 in Water
- D3648 Practices for the Measurement of Radioactivity
- D4448 Guide for Sampling Ground-Water Monitoring Wells
- D5847 Practice for Writing Quality Control Specifications for Standard Test Methods for Water Analysis
- D6001 Guide for Direct-Push Groundwater Sampling for Environmental Site Characterization

3. Terminology

3.1 Definition:

3.1.1 For definitions of terms used in this standard, see Terminologies C859 and D1129. For terms not included in these, reference may be made to other published glossaries (1, 2).³

4. Summary of Test Method

4.1 Radium is collected from the water by coprecipitation with mixed barium and lead sulfates. The barium and lead carriers are added to a solution containing alkaline citrate ion which prevents precipitation until interchange has taken place. Sulfuric acid is then used to precipitate the sulfates, which are purified by nitric acid washes. The precipitate is dissolved in ammoniacal EDTA. The barium and radium sulfates are reprecipitated by the addition of acetic acid, thereby separating them from lead and other radionuclides. The precipitate is dried on a planchet, weighed to determine the chemical yield, and alpha-counted to determine the total disintegration rate of alpha-particle-emitting radium isotopes. This procedure is based upon published ones (3, 4).

5. Significance and Use

5.1 Radium is one of the most radiotoxic elements. Its isotope of mass 226 is the most hazardous because of its long half-life. The isotopes 223 and 224, although not as hazardous, are of some concern in appraising the quality of water.

5.2 The alpha-particle-emitting isotopes of radium other than that of mass 226 may be determined by difference if radium-226 is measured separately, such as by Test Method D3454. Note that one finds ²²⁶Ra and ²²³Ra together in variable proportions (5, 6), but ²²⁴Ra does not normally occur with

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