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Standard Guide for High-Resolution Gamma-Ray Spectrometry of Soil Samples¹

This standard is issued under the fixed designation C1402; 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 guide covers the identification and quantitative determination of gamma-ray emitting radionuclides in soil samples by means of gamma-ray spectrometry. It is applicable to nuclides emitting gamma rays with an approximate energy range of 20 to 2000 keV. For typical gamma-ray spectrometry systems and sample types, activity levels of about 5 Bq (135 pCi) are measured easily for most nuclides, and activity levels as low as 0.1 Bq (2.7 pCi) can be measured for many nuclides. It is not applicable to radionuclides that emit no gamma rays such as the pure beta-emitting radionuclides hydrogen-3, carbon-14, strontium-90, and becquerel quantities of most transuranics. This guide does not address the in situ measurement techniques, where soil is analyzed in place without sampling. Guidance for in situ techniques can be found in Ref (1) and (2).² This guide also does not discuss methods for determining lower limits of detection. Such discussions can be found in Refs (3), (4), (5), and (6).

1.2 This guide can be used for either quantitative or relative determinations. For quantitative assay, the results are expressed in terms of absolute activities or activity concentrations of the radionuclides found to be present. This guide may also be used for qualitative identification of the gamma-ray emitting radionuclides in soil without attempting to quantify their activities. It can also be used to only determine their level of activities relative to each other but not in an absolute sense. General information on radioactivity and its measurement may be found in Refs (7), (8), (9), (10), and (11) and Standard Test Methods E181. Information on specific applications of gamma-ray spectrometry is also available in Refs (12) or (13). Practice D3649 may be a valuable source of information.

1.3 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.4 *This standard may involve hazardous material, operations, and equipment. 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.

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 ASTM Standards:³

- 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
- C1009 Guide for Establishing and Maintaining a Quality Assurance Program for Analytical Laboratories Within the Nuclear Industry
- D3649 Practice for High-Resolution Gamma-Ray Spectrometry of Water
- D7282 Practice for Set-up, Calibration, and Quality Control of Instruments Used for Radioactivity Measurements
- E181 Test Methods for Detector Calibration and Analysis of Radionuclides
- IEEE/ASTM-SI-10 Standard for Use of the International System of Units (SI) the Modern Metric System

2.2 ANSI Standards:⁴

- N13.30 Performance Criteria for Radiobioassay
- N42.14 Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides
- N42.23 American National Standard Measurement and Associated Instrumentation
- IEEE-325 Standard Test Procedures for Germanium Gamma-Ray Detectors

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

³ 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.

⁴ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.