



Standard Test Method for Nondestructive Analysis of Special Nuclear Materials in Homogeneous Solutions by Gamma-Ray Spectrometry¹

This standard is issued under the fixed designation C1221; 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 determination of the concentration of gamma-ray emitting special nuclear materials dissolved in homogeneous solutions. The test method corrects for gamma-ray attenuation by the solution and its container by measurement of the transmission of a beam of gamma rays from an external source (Refs. (1), (2), and (3)).²

1.2 Two solution geometries, slab and cylinder, are considered. The solution container that determines the geometry may be either a removable or a fixed geometry container. This test method is limited to solution containers having walls or a top and bottom of equal transmission through which the gamma rays from the external transmission correction source must pass.

1.3 This test method is typically applied to radionuclide concentrations ranging from a few milligrams per litre to several hundred grams per litre. The assay range will be a function of the specific activity of the nuclide of interest, the physical characteristics of the solution container, counting equipment considerations, assay gamma-ray energies, solution matrix, gamma-ray branching ratios, and interferences.

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 hazards, see Section 9.

2. Referenced Documents

2.1 ASTM Standards:³

¹ This test method is under the jurisdiction of ASTM Committee C26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.10 on Non Destructive Assay.

Current edition approved March 1, 2010. Published April 2010. Originally approved in 1992. Last previous edition approved in 2004 as C1221 – 92 (2004). DOI: 10.1520/C1221-10.

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

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.

C1133 Test Method for Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning

C1490 Guide for the Selection, Training and Qualification of Nondestructive Assay (NDA) Personnel

C1592 Guide for Nondestructive Assay Measurements

C1673 Terminology of C26.10 Nondestructive Assay Methods

C1168 Practice for Preparation and Dissolution of Plutonium Materials for Analysis

E181 Test Methods for Detector Calibration and Analysis of Radionuclides

2.2 ANSI Standards:⁴

ANSI N15.20 Guide to Calibrating Nondestructive Assay Systems

ANSI N15.35 Guide to Preparing Calibration Material for Nondestructive Assay Systems that Count Passive Gamma Rays

ANSI N15.37 Guide to the Automation of Nondestructive Assay Systems for Nuclear Material Control

ANSI N42.14 American National Standard for Calibration and Use of Germanium Spectrometers for the Measurement of Gamma-Ray Emission Rates of Radionuclides

ANSI/IEEE 645 Test Procedures for High-Purity Germanium Detectors for Ionizing Radiation

3. Terminology

3.1 For definitions of terms used in this test method, refer to Committee C26.10's Terminology standard, C1673.

4. Summary of Test Method

4.1 Many nuclear materials spontaneously emit gamma rays with energies and intensities characteristic of the decaying nuclide. The analysis for these nuclear materials is accomplished by selecting appropriate gamma rays and measuring their intensity to identify and quantify the nuclide.

4.1.1 The gamma-ray spectrum of a portion of solution is obtained with a collimated, high resolution gamma-ray detector.

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