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AMERICAN SOCIETY FOR TESTING AND MATERIALS
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Standard Test Method for Nondestructive Assay of Special Nuclear Material in Low-Density Scrap and Waste by Segmented Passive Gamma-Ray Scanning¹

This standard is issued under the fixed designation C 1133; 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 nondestructive assay of gamma-ray emitting special nuclear materials (SNMs), most commonly ²³⁵U, ²³⁹Pu, and ²⁴¹Am, in low-density scrap or waste, packaged in cylindrical containers. High-resolution gamma-ray spectroscopy is used to detect and measure the nuclides of interest and to measure and correct for gamma-ray attenuation in vertical segments of the container. Corrections are also made for counting losses occasioned by signal processing limitations **(1–3)**.²

1.2 There are currently at least three systems in use or under active development for determining the attenuation experienced by the radiation emitted from the nuclide of interest. These methods include the following: the original segmented gamma scan transmission procedure (SGS) **(4,5)**; a procedure involving measurements of the transmission at multiple energies combined with corrections for nuclide lumps based on assays of the nuclide of interest at multiple energies (MESGS) **(6–8)**; and tomographic scanning procedures (TGSS) **(9,10)**.

1.2.1 The simplest procedure, the original segmented gamma scan transmission procedure, will be covered in detail in the remainder of the main body of this test method and Annex A1.

1.2.2 Due to the limited experience and literature documenting the MESGS and TGS procedures, discussion in this test method will be limited to the above references.

1.3 Two conditions must be met to optimize SGS assay results as follows:

1.3.1 The particles containing the nuclides of interest must be small to minimize self absorption of emitted gamma radiation.

1.3.2 The mixture of material within each item segment must be sufficiently uniform to apply an attenuation correction factor, computed from a measurement of gamma-ray transmission through the segment.

1.4 The assay technique may be applicable to loadings of from one to several hundred grams of nuclide, with more

restricted ranges to be applicable depending on specific packaging and counting equipment considerations. Measured transmission values must be available to permit valid attenuation corrections.

1.5 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

1.6 *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.* Specific precautionary statements are given in Section 8.

2. Referenced Documents

2.1 ASTM Standards:

C 982 Guide for Selecting Components for Energy-Dispersive X-Ray Fluorescence (XRF) Systems³

C 1128 Guide for Preparation of Working Reference Materials for Use in the Analysis of Nuclear Fuel Cycle Materials³

C 1156 Guide for Establishing Calibration for a Measurement Method Used to Analyze Nuclear Fuel Cycle Materials³

C 1207 Test Method for Nondestructive Assay of Plutonium in Scrap and Waste by Passive Neutron Coincidence Counting³

C 1210 Guide for Establishing a Measurement System Quality Control Program for Analytical Chemistry Laboratories within the Nuclear Industry³

E 181 Test Methods for Detector Calibration and Analysis of Radionuclides⁴

2.2 ANSI Standards:⁵

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

¹ This test method is under the jurisdiction of ASTM Committee C-26 on Nuclear Fuel Cycle and is the direct responsibility of Subcommittee C26.10 on Nondestructive Assay.

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

³ *Annual Book of ASTM Standards*, Vol 12.01.

⁴ *Annual Book of ASTM Standards*, Vol 12.02.

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.