



Standard Guide for Use of Modeling for Passive Gamma Measurements¹

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1. Scope

1.1 This guide addresses the use of models with passive gamma-ray measurement systems. Mathematical models based on physical principles can be used to assist in calibration of gamma-ray measurement systems and in analysis of measurement data. Some nondestructive assay (NDA) measurement programs involve the assay of a wide variety of item geometries and matrix combinations for which the development of physical standards are not practical. In these situations, modeling may provide a cost-effective means of meeting user's data quality objectives.

1.2 A scientific knowledge of radiation sources and detectors, calibration procedures, geometry and error analysis is needed for users of this standard. This guide assumes that the user has, at a minimum, a basic understanding of these principles and good NDA practices (see Guide C1592), as defined for an NDA professional in Guide C1490. The user of this standard must have at least a basic understanding of the software used for modeling. Instructions or further training on the use of such software is beyond the scope of this standard.

1.3 The focus of this guide is the use of response models for high-purity germanium (HPGe) detector systems for the passive gamma-ray assay of items. Many of the models described in this guide may also be applied to the use of detectors with different resolutions, such as sodium iodide or lanthanum halide. In such cases, an NDA professional should determine the applicability of sections of this guide to the specific application.

1.4 Techniques discussed in this guide are applicable to modeling a variety of radioactive material including contaminated fields, walls, containers and process equipment.

1.5 This guide does not purport to discuss modeling for “infinite plane” in situ measurements. This discussion is best covered in ANSI N42.28.

1.6 This guide does not purport to address the physical concerns of how to make or set up equipment for in situ

measurements but only how to select the model for which the in situ measurement data is analyzed.

1.7 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.8 *The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.*

2. Referenced Documents

2.1 ASTM Standards:²

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

2.2 Other Standard:³

ANSI N42.28 Performance Standard for the Calibration of Germanium Detectors for In Situ Gamma-Ray Measurements

3. Terminology

3.1 See Terminology C1673.

4. Summary of Guide

4.1 Passive gamma-ray measurements are applied in conjunction with modeling to nondestructively quantify radioactivity.

4.1.1 Modeling may be used to (1) design and plan the measurements, (2) establish instrument calibration, (3) interpret the data acquired, (4) quantify contributions to the measurement uncertainty, (5) simulate spectra, and (6) evaluate the effectiveness of shielding.

¹ This practice 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.

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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.

³ Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.