

American National Standard

calibration and usage of germanium
detectors for measurement of
gamma-ray emission of radionuclides

ANSI N42.14-1978



american national standards institute, inc.

September 14, 1978

SH07492

American National Standard Calibration and Usage of Germanium Detectors for Measurement of Gamma-Ray Emission of Radionuclides

1. Introduction

1.1 The purpose of this standard is to provide a standardized basis for the calibration and usage of germanium detectors for measurement of gamma-ray emission rates of radionuclides. This standard is intended for use by knowledgeable persons who are responsible for the development of correct procedures for the calibration and usage of germanium detectors.

1.2 A typical gamma-ray spectrometry system consists of a germanium detector (with its liquid nitrogen cryostat, preamplifier, and possibly a high-voltage filter) in conjunction with a detector bias supply, linear amplifier, multichannel analyzer, and data readout device, for example, a printer, plotter, oscilloscope, or typewriter. Gamma rays interact with the detector to produce pulses which are analyzed and counted by the supportive electronics system.

1.3 A source emission rate for a gamma ray of a selected energy is determined from the counting rate in a full-energy peak of a spectrum, together with the measured efficiency of the spectrometry system for that energy and source location. It is usually not possible to measure the efficiency directly with emission-rate standards at all desired energies. Therefore a curve or function is constructed to permit interpolation between available calibration points.

2. Scope

This standard establishes methods for calibration and usage of germanium detectors for the measurement of gamma-ray emission rates of radionuclides. It covers the energy and full-energy peak efficiency calibration as well as the determination of gamma-ray energies in the 0.06 to 2 MeV energy region and is designed to yield gamma-ray emission rates with an uncertainty of ± 3 percent.¹ This standard applies primarily to measurements which do not involve overlapping peaks, and in which peak to continuum considerations are not important.

3. Definitions

certified radioactivity standard source. A calibrated radioactive source, with stated accuracy, whose calibration is certified by the source supplier as traceable to the National Radioactivity Measurements System [4].

¹Uncertainty U is given at the 68 percent confidence level; that is, $U = \sqrt{\sum \sigma_i^2 + 1/3 \sum \delta_i^2}$ where δ_i are the estimated maximum systematic uncertainties, and σ_i are the random uncertainties at the 68 percent confidence level [1]². Other methods of error analysis are in use [2], [3].

²Numbers in brackets correspond to those of the references listed in Section 7 of this standard.