

American National Standard Calibration and Usage of Thallium- Activated Sodium Iodide Detector Systems for Assay of Radionuclides

Sponsor

National Committee on Radiation Instrumentation, N42

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American National Standards Institute

Secretariat

The Institute of Electrical and Electrical Engineers, Inc.

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Abstract: Methods for performance testing, calibration, and usage of NaI(Tl) detector systems for the measurement of gamma ray emission rates of radionuclides; the assay for radioactivity; and the determination of gamma ray energies and intensities are established. Both energy calibration and efficiency calibration are covered.

Keywords: calibration, efficiency calibration, energy calibration, gamma-ray energy, radioactivity, radionuclides

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Introduction

(This introduction is not a part of ANSI N42.12-1994, American National Standard Calibration and Usage of Thallium-Activated Sodium Iodide Detector Systems for Assay of Radionuclides.)

This standard, a revision of ANSI N42.12-1980, is the responsibility of the Accredited Standards Committee N42 on Radiation Instrumentation. Committee N42 delegated the development of this standard to its Subcommittee N42.2. Drafts were reviewed by Committee N42, Subcommittee N42.RM on Radioactivity Measurements, and other interested parties, and the comments received were utilized in producing the standard as finally approved. The standard was approved by N42 letter ballot of 11 April 1994.

At the time it approved this standard, the Accredited Standards Committee on Radiation Instrumentation, N42, had the following members:

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1. Overview

1.1 Scope

This standard establishes methods for performance testing, calibration, and usage of thallium-activated sodium iodide [NaI(Tl)] detector systems for the measurement of gamma ray emission rates of radionuclides; the assay for radioactivity; and the determination of gamma ray energies and intensities. It covers both energy calibration and efficiency calibration. The following three techniques are considered:

- a) Total spectrum counting (see 4.1) employs a system that counts all pulses above a low-energy threshold (see 6.1, 6.2, and 6.3).
- b) Single-channel analyzer (SCA) counting (see 4.2) employs a system with a counting “window,” which establishes upper and lower energy boundaries (see 6.1, 6.2, and 6.3).
- c) Multichannel analyzer (MCA) counting (see 4.3) employs a system in which multiple counting windows are utilized. This technique allows measurements for which the continuum under the full-energy peak may be subtracted without introducing unacceptable error.

In case of overlapping peaks in the spectrum, it is realized that an MCA with access to a spectrum-stripping program is necessary. Such cases are not covered by this standard.

1.2 Purpose

The purpose of this document is to provide a standardized basis for the calibration and usage of sodium iodide detector systems for the measurement of gamma ray emission rates of radionuclides. Typical applications include radionuclide identification and assay in various industrial, environmental, and medical applications. An NaI(Tl) detector system consists of three major components: a scintillating medium that produces a flash of light when ionizing radiation interacts with it; one or more photomultipliers, optically coupled to the scintillator, which converts the light flash to an amplified electrical impulse; and associated electronic instrumentation that powers the photomultiplier and processes the output signal. (See IEEE Std 398-1972.¹)

¹Information on the reference can be found in clause 2.