This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

Designation: D4962 – 18

Standard Practice for NaI(Tl) Gamma-Ray Spectrometry of Water[1]

This standard is issued under the fixed designation D4962; 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 practice covers the measurement of radionuclides in water by means of gamma-ray spectrometry. It is applicable to nuclides emitting gamma-rays with energies greater than 50 keV. For typical counting systems and sample types, activity levels of about 40 Bq (1080 pCi) are easily measured and sensitivities of about 0.4 Bq (11 pCi) are found for many nuclides (**1-10**).[2] Count rates in excess of 2000 counts per second should be avoided because of electronic limitations. High count rate samples can be accommodated by dilution or by increasing the sample to detector distance.

1.2 This practice can be used for either quantitative or relative determinations. In tracer work, the results may be expressed by comparison with an initial concentration of a given nuclide which is taken as 100 %. For radioassay, the results may be expressed in terms of known nuclidic standards for the radionuclides known to be present. In addition to the quantitative measurement of gamma-ray activity, gamma-ray spectrometry can be used for the identification of specific gamma-ray emitters in a mixture of radionuclides but that ability is limited when using low energy resolution Na(Tl) detectors as compared to High Purity Germanium (HPGe) detectors. General information on radioactivity and the measurement of radiation has been published (**11 and 12**). Information on specific application of gamma-ray spectrometry is also available in the literature (**13-16**).

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses after SI units are included for information only and are not considered standard.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D1129 Terminology Relating to Water
D3648 Practices for the Measurement of Radioactivity
D7902 Terminology for Radiochemical Analyses
E181 Test Methods for Detector Calibration and Analysis of Radionuclides

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this standard, refer to Terminologies D1129 and D7902.

4. Summary of Practice

4.1 Gamma-ray spectra are commonly measured with modular equipment consisting of a detector, amplifier, analog-to-digital converter, multi-channel analyzer device, and a computer (**17 and 18**).

4.2 Thallium-activated sodium-iodide crystals, NaI(Tl), which can be operated at ambient temperatures, are often used as gamma-ray detectors in spectrometer systems. However, their energy resolution limits their use to the analysis of single nuclides or simple mixtures of a few nuclides. A resolution of about 7 % (45 keV full width at one half the ^{137}Cs peak height) at 662 keV can be expected for a NaI(Tl) detector in a 76 mm by 76 mm-configuration. There are solid scintillators such as cerium doped $LaBr_3$ that may provide a performance advantage over NaI(Tl) in terms of energy resolution but whose suitability should be evaluated and documented before being considered as a substitute for NaI(Tl).

4.3 Interaction of a gamma-ray with the atoms in a NaI(Tl) detector results in light photons that can be detected by a

[1] This practice is under the jurisdiction of ASTM Committee D19 on Water and is the direct responsibility of Subcommittee D19.04 on Methods of Radiochemical Analysis.

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[2] The boldface numbers in parentheses refer to the references at the end of this practice.

[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.

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