



Standard Test Method for GAMMA SPECTROMETRY OF WATER¹

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¹ NOTE—Section 2 was added editorially and subsequent sections renumbered in December 1981.

1. Scope

1.1 This method covers the measurement by means of gamma spectrometry of gamma radioactivity of water. It is applicable to nuclides emitting gamma rays with energies greater than 0.1 MeV. The count rate of the sample to be counted should be in the range from 10^5 counts per minute to twice the background count rate.

1.2 The method can be used for either absolute 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 if the radionuclides are known. In addition to the quantitative measurement of gamma radioactivity, gamma spectrometry can be used for the identification of specific gamma emitters in a mixture of radionuclides. General information on radioactivity and measurement of radiation has been published (1).² Information on specific application of gamma spectrometry is also available in the literature (2).

2. Applicable Document

2.1 ASTM Standard:

D 1129 Definitions of Terms Relating to Water³

3. Summary of Method

3.1 Gamma spectra are measured with a gamma-ray spectrometer. The spectrometer assembly is used to analyze the gamma spectra of radionuclides in a manner similar in general to the analysis of emission spectra of elements with the emission spectrograph. The sensing unit required for the detection of the emitted

gamma radiation is a thallium-activated sodium iodide crystal or a lithium-drifted germanium semiconductor. Interaction of a gamma photon with the atoms in a sodium iodide crystal results in a transfer of some or all of the energy of the photon to one or more electrons in the crystal. The energetic electrons collide with bound electrons, and the bound electrons are removed from the ground state orbits of the atoms. As the ground state orbits are subsequently filled, energy is released in the form of photons in the visible region which can be detected by a multiplier phototube. In a semiconductor detector, gamma photons produce electron-hole pairs, which are collected by an applied electric field. Such a device is often called a "solid state ionization chamber." A very stable, low noise preamplifier is needed, which utilizes field effect transistors; it amplifies the pulses of electric charge resulting from the gamma photon interaction.

3.1.1 The output from the multiplier phototube anode or the preamplifier is directly proportional to the energy lost by the incident gamma photon. These current pulses are fed into an amplifier of sufficient gain to produce voltage output pulses in the amplitude range typically from 0 to 10 or 0 to 100 V.

3.2 The method of analysis of the pulse spectra is by use of a pulse-height analyzer, either

¹ This method is under the jurisdiction of ASTM Committee D-19 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 list of references appended to this method.

³ *Annual Book of ASTM Standards*, Part 31.