



Designation: D5928 – 23

Standard Practice for Screening of Waste for Radioactivity¹

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1. Scope

1.1 This practice covers the screening for α -, β -, and γ radiation above ambient background levels or user-defined criteria, or both, in liquid, sludge, or solid waste materials.

1.2 This practice is intended to be a gross screening method for determining the presence or absence of radioactive materials in liquid, sludge, or solid waste materials. It is not intended to replace more sophisticated quantitative analytical techniques, but to provide a method for rapidly screening samples for radioactivity above ambient background levels or user-defined criteria, or both, for facilities prohibited from handling radioactive waste.

1.3 This practice may or may not be suitable for applications such as site assessments and remediation activities, depending on the data quality objectives or intended use.

1.4 The values stated in SI units are to be regarded as the standard.

1.5 *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.*

1.6 *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:*²

C859 Terminology Relating to Nuclear Materials

¹ This practice is under the jurisdiction of ASTM Committee D34 on Waste Management and is the direct responsibility of Subcommittee D34.01.05 on Screening Methods.

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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. Terminology

3.1 For terminology related to radioactive materials, see Terminology **C859**.

4. Summary of Practice

4.1 A sample is held within a user-specified distance of the detector window of a radiation survey meter, and the visible or audible reaction of the meter, or both, is noted. Guidance on a suitable distance is generally available in the manufacturer's instrument manual. The user defines an application/project-specific "negative" and "positive" result criteria. A "negative" test result indicates radiation levels are below the user-established criteria; a "positive" test result indicates the radiation levels are above the user-established criteria.

5. Significance and Use

5.1 Most facilities disposing or using waste materials are prohibited from handling wastes that contain radioactive materials. This practice provides the user a rapid method for screening waste material for the presence or absence of radioactivity at user-established levels that consider background radiation and the intended use of the screening method. It is important to these facilities to be able to verify generator-supplied information in regard to radiation and to meet worker health and safety needs.

6. Interferences

6.1 Needle deflections or audible clicks of the survey meter, or both, occur due to naturally occurring omnidirectional background radiation. This level of ambient background radiation should be periodically assessed. See Section 10.

6.2 Possible sources of interference include pacemakers, X-ray generating equipment, radium-based luminescent dials, polonium-based static eliminators, and smoke detectors containing a radioactive isotope-sensing mechanism. Such interferences can usually be traced to their source using the portable instrument specified in this practice.

6.3 A large amount of potassium in the waste sample may produce a positive result due to the natural presence of the radioactive isotope, potassium-40.

6.4 The sensitivity of this practice to beta and gamma radiation may be dependent on sample volume. A small sample volume with readings near background levels may give a false negative result.

6.5 Some radioactive isotopes, such as tritium/hydrogen-3 and carbon-14, may not emit radiation of sufficient energy to be detected. If suspected to be present in the waste, another procedure should be used that is appropriate to their determination.

6.6 Liquid samples, as well as moisture in solid samples, are good attenuators of radiation and will hinder detection of many radionuclides unless they emit high-energy gamma radiation. The possible inability to detect alpha particles and low-level beta emissions that may be attenuated, in many cases, should not be a serious shortcoming in this practice because these emissions are often accompanied by higher energy gamma emissions.

6.6.1 Moisture-laden, americium-241-bearing waste would be a case where there is a high probability of non-detection due to attenuation.

6.7 Survey meter contamination can cause artificially low or high results when reading standard sources or ambient background. If this occurs, the survey meter performance shall be considered unreliable and should be appropriately decontaminated and recalibrated by qualified personnel (for example, the return to the manufacturer or accredited service vendor for cleaning and calibration), or disposed of in accordance with applicable regulations.

6.8 The radiation meter should be operated in accordance with the manufacturer's instructions, and all reasonable efforts made to prevent contamination of the meter by preventing direct contact with waste materials.

7. Apparatus

7.1 *Radiation Survey Meter*, with a halogen-quenched uncompensated Geiger-Mueller tube with thin mica end window. It is advisable to choose an instrument model that has an internal counter (cpm) or is capable of operating in a scaler mode.³ The meter should be cleaned, maintained, and calibrated in accordance with instrument manufacturer specifications and recommendations.

8. Reagents and Materials

8.1 The check sources used in the development of this practice may be United States federally exempt and may not require licensing. Sources other than the following (that is, cesium-137) are appropriate for this practice. The sources, types of activity, levels of activity, and half-lives used in the development of this practice are as follows:

Source	Type	Activity	Half-Life (t _{1/2})
polonium-210	alpha	3.7 kBq	138.4 days
strontium-90	beta	3.7 kBq	28.6 years
cobalt-60	gamma	37 kBq	5.3 years

8.2 Check sources should be replaced at least every three half-lives.

9. Sample

9.1 Whether a waste is screened directly or sampled, ensure that meter distance and counting times are established to ensure the thresholds for a positive result are achievable through use of check sources in the same manner as routine sample screening with application of background and threshold levels.

9.2 Because stratification of liquid samples is possible, thoroughly mix the sample by shaking or stirring prior to testing. Strongly multiphasic samples should have each layer tested separately. Solid samples should be thoroughly mixed by a method appropriate to their size and physical characteristics.

10. Calibration and Standardization

10.1 Check the battery power source of the survey meter prior to use. If the battery check indicates that the battery charge is not in the optimal power range, it must be replaced prior to use.

10.2 Check the survey meter's performance at least daily using the α , β , and γ check sources. This is done by observing the survey meter response when held at the maximum specified distance from the meter of each check standard for a period of time and in a manner equivalent to sample screening. At a minimum, check sources should be >10 times the ambient background. The check sources listed in 9.2 far exceed this requirement.

10.3 The survey meter should be factory calibrated per the manufacturer's requirements.

10.4 Assess the level of ambient background radiation at a specified frequency. This may be prior to each test, daily, weekly, or monthly depending on user requirements.

10.4.1 Set the survey meter to the range at which it is routinely used and enable the audible alarm, if the unit is so equipped.

10.4.2 Establish the counts per minute using the time, process, and at the approximate distance routinely used for samples. Record the counts per minute. Repeat this procedure two more times, and take the average of the three repetitions using the following formula:

$$\text{Average ambient background radiation} = \frac{\text{Measurement No. 1} + \text{Measurement No. 2} + \text{Measurement No. 3}}{3}$$

10.5 Compare the results to historic values or repeat the determination in 10.4 over several days, if establishing initial background. Unexpectedly high readings for ambient background or standard sources imply that the survey meter is contaminated. See Section 6 on Interferences.

10.6 The user must define the approach to background determination as well as concentrations and criteria in writing, such as in a standard operating procedure.

³ The meter used in the development of this practice was the Monitor 4 manufactured by SE International, Inc., Summertown, TN. Through the end window, this unit is capable of detecting and indicating alpha radiation (down to 2.5 MeV with a typical detection efficiency of 80 % at 3.6 MeV), beta radiation (down to 150 keV with a typical 75 % detection efficiency), gamma radiation, and X-rays (down to 10 keV) with the survey meter set on its lowest energy range of 0.1 μ Sv/h. A number of vendors produce survey meters that are suitable for this practice.