Designation: D 5928 – 96

Standard Test Method for Screening of Waste for Radioactivity[1]

This standard is issued under the fixed designation D 5928; 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 test method 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 test method 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 test method may not be suitable for applications such as site assessments and remediation activities.

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

2. Referenced Documents

2.1 *ASTM Standards:*

C 859 Terminology Relating to Nuclear Materials[2]

3. Terminology

3.1 For terminology related to radioactive materials, see Terminology C 859.

4. Summary of Test Method

4.1 A sample is held within 6 mm of the detector window of a radiation survey meter, and the visible or audible reaction of the meter, or both, is noted. 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 utilizing waste materials are prohibited from handling wastes that contain radioactive materials. This test method provides the user a rapid method for screening waste material samples in the field or laboratory for the presence or absence of radioactivity at userestablished criteria. It is important to these facilities to be able to verify generator-supplied information that radioactive or mixed wastes have not been included in shipments of waste materials.

6. Interferences

6.1 Needle deflections or audible clicks of the survey meter, or both, occur due to naturally occurring omni-directional 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 test method.

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 test method 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 ^{3}H and ^{14}C, 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 test method 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.

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[1] This test method 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] *Annual Book of ASTM Standards*, Vol 12.01.

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 by qualified personnel, or disposed of in accordance with applicable regulations.

6.8 The radiation monitor should be operated in accordance with the manufacturer's instructions.

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.

NOTE 1—The meter used in the development of this test method was the Monitor 4.[3] A number of other survey meters[4] are suitable for this test method. 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 mr/h.

8. Reagents and Materials

8.1 The check sources used in the development of this test method were manufactured by Oxford Instruments, Inc.[5] Other suitable check sources are available from a number of suppliers.[6] The check sources used in the development of this test method are federally exempt and do not require licensing. Sources other than the following (that is, Cesium 137) are appropriate for this test method. The sources, levels of activity, and half-lives used in the development of this test method are as follows:

Source	Type	Activity	Half-Life ($t_{1/2}$)
Polonium 210	alpha	0.1 μCi	138.4 days
Strontium 90	beta	0.1 μCi	28.6years
Cobalt 60	gamma	1.0 μCi	5.3years

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

9. Sample

9.1 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 within 6 mm of each check standard. At a minimum, check sources should be >2 times the ambient background. The check sources listed in 9.1 far exceed this requirement.

10.3 The survey meter should be factory-calibrated at least yearly.

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

10.4.1 Set the survey meter to its X1 or most sensitive setting and enable the audible alarm, if unit is so equipped.

10.4.2 Record the number of audible meter clicks over a period of 60 s (counts per minute). Repeat this procedure two more times, and take the average of the three repetitions using the following formula:

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

10.5 Unexpectedly high readings for ambient background or standard sources infers that the survey meter is contaminated. See the section on Interferences.

10.6 The user must clearly define the criteria to be used for reporting "negative" or "positive" test results. These criteria may be project- or application-specific. A common defining point used is "two to three times the ambient background level."

11. Procedure

11.1 Perform the necessary steps presented in Section 10.

11.2 Allow the survey meter to stabilize for 10 to 15 s at its X1 or lowest appropriate setting.

11.3 Place the end-window of the survey meter within 6 mm of the sample. Depending on the physical characteristics of the sample container (for example, the container is such that the sample is >6 mm from the opening), it may be necessary to withdraw a representative portion of the sample to an alternate sample container, watch glass, or other appropriate vessel to allow the end-window to be placed within 6 mm of the sample. Do not allow the survey meter to come in direct contact with the sample. This may contaminate the meter and may damage the end-window.

11.4 Record the counts per minute for a period of 60 s (counts per minute).

11.5 If the counts per minute are above the user-defined criteria, then the sample may contain radioactive material.

NOTE 2—The user should recognize the potential interferences mentioned in Section 6.

11.6 If radioactivity levels above the user-defined criteria are observed, the background levels should be redetermined as described in Section 10. The sample should then be retested beginning with 11.2.

11.7 If radioactivity levels are confirmed to be above the user-defined criteria, sample testing should be discontinued, and the appropriate health and safety professional or site regulatory officer should be contacted for further instructions.

[3] Manufactured by SE International, Inc., Summertown, TN.

[4] For example, Five Level Portable Meter, manufactured by Harshaw-Bicron, Inc., Solon, OH; Ludlum Measurements, Inc., Sweetwater, TX; and Eberline Instrument Corp., Santa Fe, NM.

[5] Oxford Instruments, Inc., Oak Ridge, TN.

[6] For example, The Source, Inc., Santa Fe, NM; Ludlum Measurements, Inc., Sweetwater, TX; and Eberline Instrument Corp., Santa Fe, NM.

11.8 If radioactivity levels are below the user-defined criteria, the test result may be recorded as not detected.

12. Precision and Bias

12.1 *Precision*—No statement is made about the precision because this screening test method produces only a positive or negative test result.

12.2 *Bias*—No statement is made about the bias because this screening test method produces only a positive or negative test result.

13. Keywords

13.1 radioactivity; screening method; waste materials