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Standard Guide for Designing Biological Tests with Sediments¹

This standard is issued under the fixed designation E1525; 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 As the contamination of freshwater and saltwater ecosystems continues to be reduced through the implementation of regulations governing both point and non-point source discharges, there is a growing emphasis and concern regarding historical inputs and their influence on water and sediment quality. Many locations in urban areas exhibit significant sediment contamination, which poses a continual and long-term threat to the functional condition of benthic communities and other species inhabiting these areas (1).² Benthic communities are an important component of many ecosystems and alterations of these communities may affect water-column and nonaquatic species.

1.2 Biological tests with sediments are an efficient means for evaluating sediment contamination because they provide information complementary to chemical characterizations and ecological surveys (2). Acute sediment toxicity tests can be used as screening tools in the early phase of an assessment hierarchy that ultimately could include chemical measurements or bioaccumulation and chronic toxicity tests. Sediment tests have been applied in both saltwater and freshwater environments (2-6). Sediment tests have been used for dredge material permitting, site ranking for remediation, recovery studies following management actions, and trend monitoring. A particularly important application is for establishing contaminant-specific effects and the processes controlling contaminant bioavailability(7).

1.3 This guide is arranged as follows:

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1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are for information only.

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. For specific hazard statements, see Section 7.*

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:³

- D1129 Terminology Relating to Water
- D4447 Guide for Disposal of Laboratory Chemicals and Samples
- E724 Guide for Conducting Static Short-Term Chronic Toxicity Tests Starting with Embryos of Four Species of Saltwater Bivalve Molluscs
- E729 Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates, and Amphibians
- E943 Terminology Relating to Biological Effects and Environmental Fate (Withdrawn 2023)⁴
- E1023 Guide for Assessing the Hazard of a Material to Aquatic Organisms and Their Uses
- E1367 Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Estuarine and Marine Invertebrates

¹ This guide is under the jurisdiction of ASTM Committee E50 on Environmental Assessment, Risk Management and Corrective Action and is the direct responsibility of Subcommittee E50.47 on Biological Effects and Environmental Fate.

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² The boldface numbers in parentheses refer to the list of references at the end of this standard.

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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

*A Summary of Changes section appears at the end of this standard

E1383 Guide for Conducting Sediment Toxicity Tests with Freshwater Invertebrates (Withdrawn 1995)⁴

E1391 Guide for Collection, Storage, Characterization, and Manipulation of Sediments for Toxicological Testing and for Selection of Samplers Used to Collect Benthic Invertebrates

E1563 Guide for Conducting Short-Term Chronic Toxicity Tests with Echinoid Embryos

E1611 Guide for Conducting Sediment Toxicity Tests with Polychaetous Annelids

E1676 Guide for Conducting Laboratory Soil Toxicity or Bioaccumulation Tests with the Lumbricid Earthworm *Eisenia Fetida* and the Enchytraeid Potworm *Enchytraeus albidus*

E1688 Guide for Determination of the Bioaccumulation of Sediment-Associated Contaminants by Benthic Invertebrates

E1706 Test Method for Measuring the Toxicity of Sediment-Associated Contaminants with Freshwater Invertebrates

IEEE/ASTM SI-10 Standard for Use of the International System of Units (SI): The Modern Metric System

2.2 Other Standards:

Title 29 Code of Federal Regulations 1910.132 (f)⁵

3. Terminology

3.1 Definitions:

3.1.1 The words “must,” “should,” “may,” “can,” and “might” have very specific meanings in this guide. “Must” is used to express an absolute requirement, that is, to state that the test ought to be designed to satisfy a specific condition, unless the purpose of the test requires a different design. “Must” is used only in connection with the factors that apply directly to the acceptability of the test. “Should” is used to state that the specified conditions are recommended and ought to be met in most tests. Although a violation of one “should” is rarely a serious matter, violation of several will often render the results questionable. Terms such as “is desirable,” “is often desirable,” and “might be desirable” are used in connection with less important factors. “May” is used to mean “is (are) allowed to,” “can” is used to mean “is (are) able to,” and “might” is used to mean “could possibly.” Thus, the classic distinction between “may” and “can” is preserved, and “might” is never used as a synonym of either “may” or “can.”

3.1.2 For definitions of terms used in this guide, refer to Guide E729, Terminologies D1129 and E943, and Guide E1023. For an explanation of the units and symbols, refer to IEEE/ASTM SI-10.

3.2 Definitions of Terms Specific to This Standard:

3.2.1 *bioaccumulation*—the net uptake of a material by an organism from its environment through exposure by means of water and food.

3.2.2 *concentration*—the ratio of the weight or volume of test material(s) to the weight or volume of test sample.

3.2.3 *control sediment*—a sediment that is essentially free of contaminants and is used routinely to assess the acceptability of a test.

3.2.4 *elutriate*—the water and soluble portion extracted from the sediment.

3.2.5 *exposure*—contact with a chemical or physical agent.

3.2.6 *overlying water*—the water placed over the solid phase of a sediment in the test chamber for the conduct of the biological test; this may also include the water used to manipulate the sediments. In field situations, the water column above the sediment/water interface.

3.2.7 *pore water/interstitial water*—water occupying space between sediment or soil particles.

3.2.8 *reference sediment*—a whole sediment near the area of concern used to assess sediment conditions exclusive of material(s) of interest.

3.2.9 *sediment*—(1) particulate material that usually lies below water and (2) formulated particulate matter that is intended to lie below water in a test.

3.2.10 *spiked sediment*—a sediment to which a material has been added for experimental purposes.

3.2.11 *suspension*—a slurry of sediment and water.

3.2.12 *toxicity*—the property of a material or combination of materials to affect organisms adversely.

3.2.13 *whole sediment*—sediment and associated pore water that has had minimal manipulation following collection or formulation.

4. Application

4.1 An ASTM guide outlines a series of options or instructions and does not recommend a specific course of action. The purpose of a guide is to offer guidance, based on a consensus of viewpoints, but not to establish a fixed procedure. A guide is intended to increase the awareness of the user to available techniques in a given subject area and to provide information from which subsequent evaluation and standardization can be derived.

4.2 This guide provides general interpretative guidance on the selection, application, and interpretation of biological tests with sediments. As such, this guide serves as a preface to other ASTM documents describing methods for sediment collection, storage, and manipulation (Guide E1391); and toxicity or bioaccumulation tests with sediment (Guides E724, E1367, E1391, E1611, E1563, E1688, and Test Method E1706). Much of the guidance presented in this standard is also applicable to toxicity testing of soils (Guide E1676). This guide serves as an introduction and summary of sediment testing and is not meant to provide specific guidance on test methods. Rather, its intent is to provide information necessary to accomplish the following:

4.2.1 Select a sediment exposure strategy appropriate to the assessment need. For example, a suspended phase exposure is relevant to the evaluation of dredged sediments for disposal at a dispersive aquatic site. (See Annex A1).

4.2.2 Select the test organism and biological endpoints appropriate to the desired exposure and aquatic resources at

⁵ Available from Superintendent of Documents, U.S. Government Printing Office, Washington DC 20402.