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Standard Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials[1]

This standard is issued under the fixed designation D7007; 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 These practices cover standard procedures for using electrical methods to locate leaks in geomembranes covered with water or earthen materials. For clarity, this practice uses the term "leak" to mean holes, punctures, tears, knife cuts, seam defects, cracks, and similar breaches in an installed geomembrane (as defined in 3.2.9).

1.2 These practices are intended to ensure that leak location surveys are performed with a standardized level of leak detection capability. To allow further innovations, and because various leak location practitioners use a wide variety of procedures and equipment to perform these surveys, performance-based protocol are also used that specify minimum leak detection criteria.

1.3 The survey shall then be conducted using the demonstrated equipment, procedures, and survey parameters. In the absence of the minimum signal strength during leak detection distance testing, a minimum measurement density specification is provided. Alternatively, the minimum measurement density may simply be used.

1.4 Separate procedures are given for leak location surveys for geomembranes covered with water and for geomembranes covered with earthen materials. Separate procedures are given for leak detection distance tests using actual and artificial leaks.

1.5 Examples of methods of data analysis for soil-covered surveys are provided as guidance in Appendix X1.

1.6 Leak location surveys can be used on geomembranes installed in basins, ponds, tanks, ore and waste pads, landfill cells, landfill caps, and other containment facilities. The procedures are applicable for geomembranes made of materials such as polyethylene, polypropylene, polyvinyl chloride, chlorosulfonated polyethylene, bituminous material, and other electrically insulating materials.

1.7 The values stated in SI units are to be regarded as standard. No other units of measurement are included in this standard.

1.8 (**Warning—**The electrical methods used for geomembrane leak location could use high voltages, resulting in the potential for electrical shock or electrocution. This hazard might be increased because operations might be conducted in or near water. In particular, a high voltage could exist between the water or earthen material and earth ground, or any grounded conductor. These procedures are potentially VERY DANGEROUS, and can result in personal injury or death. The electrical methods used for geomembrane leak location should be attempted only by qualified and experienced personnel. Appropriate safety measures must be taken to protect the leak location operators as well as other people at the site.)

1.9 *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.*

1.10 *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]

D4439 Terminology for Geosynthetics

D6747 Guide for Selection of Techniques for Electrical Leak Location of Leaks in Geomembranes

3. Terminology

3.1 For general definitions related to geosynthetics, see Terminology D4439.

3.2 *Definitions of Terms Specific to This Standard:*

[1] These practices are under the jurisdiction of ASTM Committee D35 on Geosynthetics and are the direct responsibility of Subcommittee D35.10 on Geomembranes.

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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.

3.2.1 *artificial leak, n*—an electrical simulation of a leak in a geomembrane.

3.2.2 *conductive-backed geomembrane, n*—a geomembrane that is manufactured with one surface that is conductive.

3.2.3 *conductive drainage geocomposite, n*—a drainage geocomposite manufactured with one or several conductive geotextiles.

3.2.4 *conductive geotextile, n*—a geotextile manufactured with an electrically conductive element or fiber or external treatment to make it electrically conductive.

3.2.5 *current source electrode, n*—the electrode that is placed in the water or earthen material above the geomembrane.

3.2.6 *dipole measurement, n*—an electrical measurement made on or in a partially conductive material using two closely spaced electrodes.

3.2.7 *earthen material, n*—sand, gravel, clay, silt, combinations of these materials, and similar materials with at least minimal moisture for electrical current conduction.

3.2.8 *functionality testing, n*—for the purposes of these practices, functionality testing is a demonstration that a testing circuit is installed in order to detect an artificial or actual leak using the proposed equipment settings and survey procedures. Functionality testing may be used to determine the measurement density through the use of leak detection distance testing.

3.2.9 *leak, n*—for the purposes of these practices, a leak is any unintended opening, perforation, breach, slit, tear, puncture, crack, or seam breach. Significant amounts of liquids or solids may or may not flow through a leak. Scratches, gouges, dents, or other aberrations that do not completely penetrate the geomembrane are not considered to be leaks. Types of leaks detected during surveys include, but are not limited to: burns, circular holes, linear cuts, seam defects, tears, punctures, and material defects.

3.2.10 *noise, n*—the unwanted part of a measured signal contributed by phenomena other than the desired signal.

3.2.11 *pole measurement, n*—an electrical measurement made on or in a partially conductive material using one measurement electrode and a remote reference electrode.

3.2.12 *potential, n*—electrical voltage measured relative to a reference point.

3.2.13 *site response current, n*—the value of current, typically expressed in milliamps, resulting from applying a voltage to a current source electrode inserted into the material covering the geomembrane in the survey area with the current return electrode connected to the underlying conductive layer.

4. Significance and Use

4.1 Geomembranes are used as impermeable barriers to prevent liquids from leaking from landfills, ponds, and other containments. The liquids may contain contaminants that, if released, can cause damage to the environment. Leaking liquids can erode the subgrade, causing further damage. Leakage can result in product loss or otherwise prevent the installation from performing its intended containment purpose. For these reasons, it is desirable that the geomembrane have as little leakage as practical.

4.2 Geomembrane leaks can be caused by poor quality of the subgrade, poor quality of the material placed on the geomembrane, accidents, poor workmanship, manufacturing defects, and carelessness.

4.3 The most significant causes of leaks in geomembranes that are covered with only water are related to construction activities, including pumps and equipment placed on the geomembrane, accidental punctures, and punctures caused by traffic over rocks or debris on the geomembrane or in the subgrade.

4.4 The most significant cause of leaks in geomembranes covered with earthen materials is construction damage caused by machinery that occurs while placing the earthen material on the geomembrane. Such damage also can breach additional layers of the lining system such as geosynthetic clay liners.

4.5 Electrical leak location methods are an effective final quality assurance measure to detect and locate leaks. If any of the requirements for survey area preparation is not adhered to, then leak sensitivity could be diminished. Optimal survey area conditions are described in Section 6.

5. Summary of the Electrical Leak Location Methods for Covered Geomembranes

5.1 The principle of the electrical leak location method is to place a voltage across a geomembrane and then locate the points of anomalous potential distribution where electrical current flows through leaks in the geomembrane. Additional information can be found in Guide D6747.

5.2 *General Principles:*

5.2.1 Figs. 1 and 2 show diagrams of the electrical leak location method for a geomembrane covered with water and for a geomembrane covered with earthen materials, respectively. One output of an electrical excitation power supply is connected to a current source electrode placed in the material covering the geomembrane. The other output of the power supply is connected to an electrode in contact with electrically conductive material under the geomembrane.

5.2.2 When there are leaks, electrical current flows through the leaks, which produces high current density and a localized anomaly in the voltage potential distribution in the material above the geomembrane. Electrical measurements are made to locate those areas of anomalous signal at the leaks.

5.2.3 Measurements are made using a dipole or pole measurement configuration. Various types of data acquisition are used, including audio indications of the signal level, manual measurements with manual recording of data, and automated digital data acquisition.

5.2.4 Direct current and alternating current excitation power supplies and potential measurement systems have been used for leak location surveys.

5.3 *Leak Location Surveys of Geomembranes Covered with Water:*