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Standard Practices for Permanent Monitoring Systems for Electrical Leak Detection and Location[1]

This standard is issued under the fixed designation D8551; 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 describe standard procedures for using electrical methods to locate leaks in geomembranes covered with liquid, earthen materials, waste, and/or any material deposited on the geomembrane.

1.2 These practices are intended to ensure that permanent leak detection and location systems are effective, which can result in complete containment (no leaks in the geomembrane).

1.3 Not all sites will be easily amenable to this method, but some preparation can be performed in order to enable this method at nearly any site as outlined in Section 6. If ideal testing conditions cannot be achieved (or designed out), the method can still be performed, but any issues with site conditions must be documented.

1.4 Permanent monitoring systems for electrical leak detection and location can be used on geomembranes installed in basins, ponds, tanks, ore and waste pads, landfill cells, landfill caps, and other containment facilities including civil engineering structures. The procedures are applicable for geomembranes made of materials such as polyethylene, polypropylene, polyvinyl chloride, chlorosulfonated polyethylene, bituminous material, and other sufficiently electrically insulating materials.

1.5 Any permanent electrical monitoring system must detect the occurrence of a leak through the geomembrane, and it must last longer than the monitored geomembrane by nature of the concept. Therefore, all buried components and mechanical and electrical connections must be made of material either the same as the geomembrane, in case of sensors situated above geomembrane, or made from a material with a longer lifespan in cases where they are situated under the monitored geomembrane.

1.6 Permanent electrical monitoring systems are comprised of either large mesh pads separated by nominal spaces, or a grid of sensors situated either below the geomembrane or above the geomembrane or in both positions (below and above the geomembrane). In specific cases, sensors may be situated only at the perimeter of the monitored lined facility.

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 The electrical methods used for geomembrane leak location should be attempted only by qualified and experienced personnel. Appropriate safety measures should 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

D7002 Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Puddle Method

D7007 Practices for Electrical Methods for Locating Leaks in Geomembranes Covered with Water or Earthen Materials

D7703 Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance Method

D7909 Guide for Placement of Intentional Leaks During Electrical Leak Location Surveys of Geomembranes

[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.

D7953 Practice for Electrical Leak Location on Exposed Geomembranes Using the Arc Testing Method
D8265 Practices for Electrical Methods for Mapping Leaks in Installed Geomembranes

3. Terminology

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

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *actual leak, n*—for the purposes of this standard, the term "actual leak" is used for a leak to distinguish it from an artificial leak.

3.2.2 *anomaly (anomalies, pl), n*—electrical measurement caused by some aberration in the measurement area, which may or may not be a leak.

3.2.3 *artificial leak, n*—for the purposes of this standard, an artificial leak is the temporary use of a sensor electrode or supply electrode, which is used to electrically mimic a leak in the lining system and is used to confirm functionality without creating an actual leak in the lining system.

3.2.4 *blind leak, n*—for the purposes of this standard, a blind leak is a circular hole in the geomembrane intentionally placed by the owner or owner's representative in a location unknown to the leak location practitioner.

3.2.5 *conductive-backed geomembrane, n*—a specialty geomembrane featuring a conductive backing.

3.2.6 *conductive geotextile, n*—a specialty geotextile manufactured to be electrically conductive for use in multilayer geosynthetic arrangements.

3.2.7 *dipole measurement, n*—an electrical measurement made on or in a partially conductive material using closely spaced sensors carried over the covering layer and placed at equal centers to measure the entire surface for evidence of anomalies (see Practices D7007 and D8265).

3.2.8 *earthen material, n*—sand, gravel, clay, silt, combinations of these materials, waste materials, or similar materials with an approximate conductivity <50 kΩ/m.

3.2.9 *electrically isolated conductive-backed geomembrane installation, n*—an installation of conductive-backed geomembrane that achieves a continuously conductive surface on the bottom layer while electrically isolating the bottom conductive layer from the top insulating layer of the entire geomembrane installation.

3.2.10 *known leak, n*—for the purposes of this standard, a known leak is a circular hole in the geomembrane intentionally placed by the owner or owner's representative per Guide D7909.

3.2.11 *leak, n*—for the purposes of this standard, a leak is any opening, perforation, breach, slit, tear, puncture, crack, or seam breach in the lining system. Moisture/humidity or direct mineral contact should be present through a "leak" in order to produce an anomaly. Scratches, gouges, dents, or other aberrations that do not completely penetrate the geomembrane are not considered to be leaks. Types of leaks detected during measurements include but are not limited to: burns, circular holes, linear cuts, seam defects, tears, punctures, and material defects.

3.2.12 *measurement, n*—for the purposes of this standard, a measurement is an electrical evaluation of a geomembrane-lined containment facility to check for leaks in the geomembrane.

3.2.13 *measurement area, n*—the portion of the geomembrane-lined containment facility subjected to an electrical leak location measurement.

3.2.14 *monitoring, n*—for the purpose of this standard, monitoring is a repeated measurement of the measurement area to enable the detection of leaks as and when they occur.

3.2.15 *point sensor, n*—a sensor placed in a discrete location of a gridded network.

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

3.2.17 *power source, n*—the direct current (DC) power supply used by leak location practitioners and permanent systems in order to create a voltage differential across the geomembrane.

3.2.18 *primary geomembrane, n*—the geomembrane constituting the first containment layer in a lining system containing multiple geomembranes.

3.2.19 *probe(s), n*—a conductive object used to make electrical measurements.

3.2.20 *return electrode, n*—the electrode that is used as reference pole to the current source electrode and it is placed outside of measurement area, or on the opposite side of the geomembrane as the current source electrode.

3.2.21 *sensing electrode(s), n*—see *sensor*; alternative noun used by leak location practitioners.

3.2.22 *sensor(s), n*—the electrodes that are used as receptors of the electric leak location signals for measuring either voltage (V) or current (A). They are placed either below the geomembrane or above the geomembrane or on both sides of geomembrane. These are usually manufactured using conductive and corrosion-resistant material such as 316L stainless steel or titanium, or alternatively of semiconductive HDPE.

3.2.23 *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 measurement area with the current return electrode connected to the underlying conductive layer in case of multiple geomembranes or to the earth in case of single geomembrane construction.

3.2.24 *source electrode, n*—the electrode used to apply current to the material above the geomembrane.

3.2.25 *zonal sensors, n*—a form of sensor that is not a point sensor but instead covers a large area and is formed of electrically conductive mesh, which has a ratio of 1:1 (leak location resolution to physical sensor size).

4. Significance and Use

4.1 Geomembranes are used as impermeable barriers to prevent liquids leaking out of landfills, ponds, and other