INTERNATIONAL

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Standard Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance Method[1]

This standard is issued under the fixed designation D7703; 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 practice is a performance-based standard for an electrical method for locating leaks in exposed geomembranes. 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 3.2.53.2.6).

1.2 This practice can be used for geomembranes installed in basins, ponds, tanks, ore and waste pads, landfill cells, landfill caps, canals, and other containment facilities. It is applicable for geomembranes made of materials such as polyethylene, polypropylene, polyvinyl chloride, chlorosulfonated polyethylene, bituminous geomembrane, and any other electrically insulating materials. This practice is best applicable for locating geomembrane leaks where the proper preparations have been made during the construction of the facility.

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

1.4 *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 safety, health, and healthenvironmental practices and determine the applicability of regulatory limitations prior to use.*

1.5 *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

[1] This practice is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is 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

3. Terminology

3.1 *Definitions:*

3.1.1 For general definitions used in this practice, refer to Terminology D4439.

3.2 *Definitions of Terms Specific to This Standard:*

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

3.2.2 *conductive-backed geomembrane, n*—a speciality geomembrane manufactured using coextrusion technology featuring an insulating layer in intimate contact with a conductive layer.

3.2.3 *current, n*—the flow of electricity or the flow of electric charge.

3.2.4 *electrical leak location, n*—a method which uses electrical current or electrical potential to locate leaks in a geomembrane.

3.2.5 *functionality testing, n*—for the purposes of this practice, functionality testing is a demonstration of the ability to detect an artificial or actual leak using the proposed equipment settings and survey procedures.

3.2.6 *leak, n*—for the purposes of this practice, 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. Type of leaks detected during surveys include, but are not limited to: burns, circular holes, linear cuts, seam defects, tears, punctures, and material defects.

3.2.6 *leak detection sensitivity, n*—the smallest leak that the leak location equipment and survey methodology are capable of detecting under a given set of conditions. The leak detection sensitivity specification is usually stated as a diameter of the smallest leak that can likely be detected.

3.2.7 *poor contact condition, n*—for the purposes of this practice, a poor contact condition means that a leak is not in intimate contact with the conductive layer above or underneath the geomembrane to be tested. This occurs on a wrinkle or wave, under the overlap flap of a fusion weld, in an area of liner bridging, and in an area where there is a subgrade depression or rut.

3.2.8 *probe, n*—for the purposes of this practice, any conductive rod that is attached to a power source.

3.2.9 *water stream, n*—for the purposes of this practice, a continuous stream of water between the water lance and the geomembrane that creates a conduit for current to flow through any leaks.

3.2.9 *water lance, n*—for the purposes of this practice, a probe (lance) incorporating one or two electrodes that directs a solid stream of water through a single nozzle mounted at the end.

3.2.10 *water stream, n*—for the purposes of this practice, a continuous stream of water between the water lance and the geomembrane that creates a conduit for current to flow through any leaks.

4. Significance and Use

4.1 Geomembranes are used as barriers to prevent liquids from leaking from landfills, ponds, and other containments. For this purpose, it is desirable that the geomembrane have as little leakage as practical.

4.2 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.

4.3 Geomembranes are often assembled in the field, either by unrolling and welding panels of the geomembrane material together in the field, unfolding flexible geomembranes in the field, or a combination of both.

4.4 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.

4.5 Electrical leak location methods are an effective and proven quality assurance measure to detect and locate leaks. They do not verify material or seam integrity.

5. Summary of Exposed Geomembrane Electrical Leak Location Methods

5.1 *Principles of the Electrical Leak Location Methods for Exposed Geomembranes:*

5.1.1 The principle of the electrical leak location methods is to place a voltage across a geomembrane and then locate areas where electrical current flows through leaks in the geomembrane.

5.1.2 Currently available methods include the water puddle method (Practice D7002), the arc testing method (Practice D7953), and the water lance method.

5.1.3 All of the methods listed in 5.1.2 are effective at locating leaks in exposed geomembranes. Each method has specific site and labor requirements, survey speeds, advantages, and limitations. A professional specializing in the electrical leak location methods can provide advice on the advantages and disadvantages of each method for a specific project.

5.1.4 Alternative ASTM ~~Standard Practices~~standard practices for electrical leak location survey methods should be allowed when mutually agreeable and warranted by adverse site conditions, clearly technical superiority, logistics, or schedule.

6. Water Lance Method

6.1 A summary of the method capabilities and limitations is presented in Table 1.

6.2 *The Principle of the Water Lance Method:*

6.2.1 Fig. 1 shows a diagram of electrical leak location using the water lance method for exposed geomembranes. One output of an electrical excitation power supply is connected to an electrode placed in the water reservoir; a pump sends this charged water to the water lance that jets the water in a solid stream on top of the geomembrane. The other output of the power supply is connected to an electrode placed in electrically conductive material under the geomembrane.

TABLE 1 Summary of Water Lance Method

Geomembranes	Bituminous, CSPE, CPE, EIA, fPP, HDPE, LLDPE, LDPE, PVC, VLDPE,	✓	applicable
	Conductive-backed Geomembrane	✓	applicable[A]
Seams	All types: welded, tape, adhesive, glued, and other	✓	applicable: project specific
Junctions	At synthetic pipes and accessories	✓	applicable: project specific
	At grounded conducting structures	X	not applicable
Survey	During construction phase (installation of GM)	✓	applicable
	After installation (exposed)	✓	applicable
	Slopes	✓	applicable: project specific
	Insufficiently conductive subgrade	X	not applicable
	During the service life (if exposed)	✓	project specific
Climate	Sunny, temperate, warm	✓	applicable
	Rainy weather	X	not applicable
	Frozen conditions	X	not applicable
Leaks detected	Discrimination between multiple leaks	✓	applicable

[A] If used, conductive-backed geomembrane must be installed per the manufacturer's recommendations in order to allow it to be tested using all of the available electrical leak location methods. In particular, there must be some means to break the conductive path through the fusion welds along the entire lengths of the welds, the undersides of adjacent panels (and patches) should be electrically connected together, and a means of preventing unwanted grounding at the anchor trenches or other unwanted earth grounds should be provided.

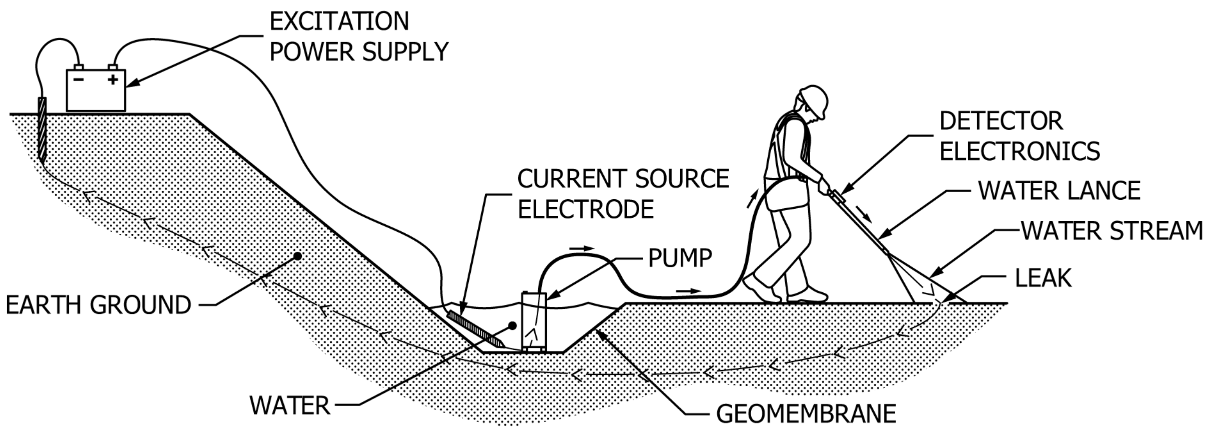

FIG. 1 Diagram of the Water Lance Method Using Voltage Measurement

6.2.2 The water lance method can also be set up with the same configuration as the water puddle method, as shown in Fig. 2, if the detector electronics are capable of measuring current and converting that to an audible alarm.

6.3 *Leak Location Surveys of Exposed Geomembrane Using the Water Lance Method:*

6.3.1 The water lance leak location method usually consists of a single nozzle mounted at the end of a probe (lance) that directs a solid stream of water onto a geomembrane, and an electronic detector assembly, as shown in Figs. 1 and 2. A pressurized water source, usually from a reservoir on top of the ~~liner,~~liner or from a tank truck isolated from ground parked at higher elevation, is connected to the water lance using a plastic or rubber hose.

6.3.2 Direct current power supplies (often a 12 to 36 volt battery or series of batteries) have been used for water lance leak location surveys.

6.3.3 For leak location surveys of exposed geomembrane, the solid water stream (not a spray) is moved systematically over the geomembrane area to locate the points where the electrical current flow increases as the charged water from the water lance contacts the oppositely charged conductive media under the geomembrane through a hole.

6.3.4 The voltage drop signal between the two electrodes in the water column in the water lance (or the current flow through the detector electronics) is connected to an electronic detector assembly that converts the electrical signal to an audible signal that increases in pitch and amplitude as the leak signal increases.

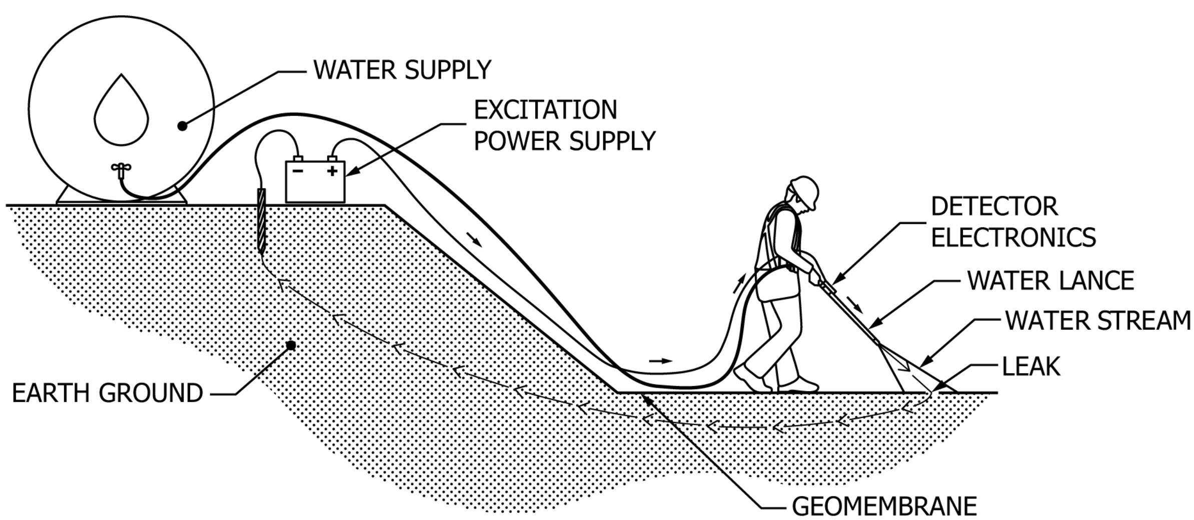

FIG. 2 Diagram of the Water Lance Method Using Current Measurement