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Designation: D7002 – 16 D7002 – 22

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

This standard is issued under the fixed designation D7002; 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.

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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.*

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

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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 specialty 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.

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 document, 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.

~~3.2.6 *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.~~

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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.

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

3.2.9 *squeegee, n*—for the purposes of this document, a squeegee is a device used to contain and push water on top of an exposed geomembrane. It may consist of a handle and a transverse piece at one end set with a strip of leather or rubber, or a roller apparatus.

3.2.10 *water puddle, n*—a small pool of water placed on the geomembrane to create 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 lance method (Practice D7703), the arc testing method (Practice D7953), and the water puddle 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 Puddle Method

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

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NOTE 1—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.

6.2 *Principle of the Water Puddle Method:*

6.2.1 Fig. 1 shows a diagram of electrical leak location using the water puddle method for exposed geomembranes. One output of an electrical excitation power supply is connected to an electrode placed in a water puddle created on top of the geomembrane. The other output of the power supply is connected to an electrode placed in the electrically conductive material under the geomembrane.

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6.2.2 Measurements are made using an electrical current measurement system. An electronic assembly is used to produce an audio tone whose frequency is proportional to the current flow.

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

TABLE 1 Summary of Water Puddle 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 or other unwanted earth grounds should be provided.

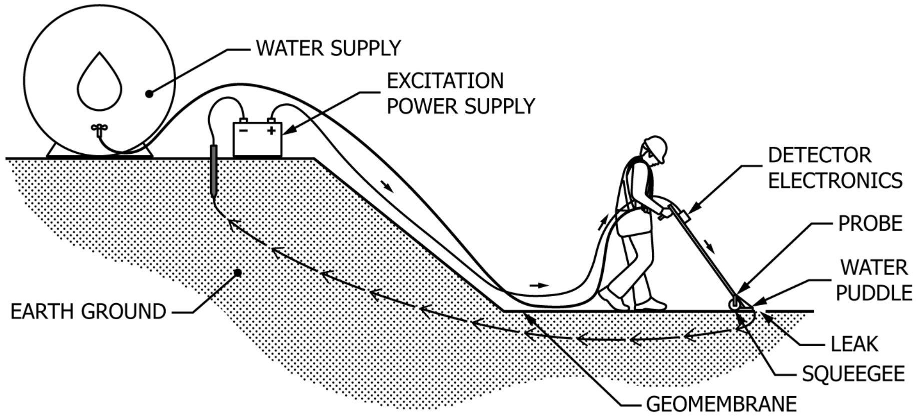

FIG. 1 Diagram of the Water Puddle Method

6.3.1 The water puddle leak location method usually consists of a horizontal water spray manifold with multiple nozzles that spray water onto a geomembrane, a squeegee device to push the resultant puddle of water, and a handle assembly as shown in Fig. 1. A pressurized water source, usually from a tank truck parked at higher elevation, is connected to the spray manifold using a plastic or rubber hose.

6.3.2 Direct current power supplies (usually a 12 to 36 volt battery or series of batteries) have been used for leak location surveys. An alternating current (output requirement of 12 to 30 volt ac) could be used.

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6.3.3 For leak location surveys of exposed geomembrane, the water puddle created is pushed systematically over the geomembrane area to locate the points where the electrical current flow increases.

6.3.4 The signal from the probe is typically connected to an electronic detector assembly that converts the electrical signal to an audible signal that increases in pitch and amplitude as the electrical current increases.

6.3.5 When a leak signal is detected, the location of the leak is then marked or measured relative to fixed points.

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6.3.6 The leak detection sensitivity can be very good for this technique. Leaks smaller than 1 mm in diameter are routinely found, including leaks through seams in the geomembrane.

6.3.7 The survey rate depends primarily on the manifold and squeegee width and the presence of wrinkles and waves in the geomembrane.

6.4 *Preparations and Measurement Considerations:*

6.4.1 Proper field preparations and other measures shall be implemented to ensure that an electrical connection to the sufficiently conductive material directly below the geomembrane is in place to successfully complete the leak location survey.

6.4.2 There shall be a sufficiently conductive material below the geomembrane being tested. A ~~properly-prepared~~ properly prepared subgrade typically will have ~~sufficiently~~sufficient conductivity. Under proper conditions and preparations, geosynthetic clay liners (GCLs) can be adequate as conductive material. There are some other conductive layers such as conductive geotextiles and aluminum foils with successful field experience which can be installed beneath the geomembrane to facilitate electrical leak survey (that is, on dry subgrades, or as part of a planar drainage geocomposite).

6.4.3 Measures should be taken to perform the leak location survey when geomembrane wrinkles are minimized. If a hole is located on a wrinkle, then this poor contact condition may result in an undetected leak. The leak location survey should be conducted at night or early morning when wrinkles are minimized. Sometimes wrinkles can be flattened by personnel walking or standing on them as the survey progresses.

6.4.4 Conversely, surveys should not be made in areas with bridging geomembrane. The survey of areas with minor bridging might be accomplished when the geomembrane is warmer.