Designation: D7909 – 14

Standard Guide for Placement of Blind Actual Leaks during Electrical Leak Location Surveys of Geomembranes[1]

This standard is issued under the fixed designation D7909; 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 guide is for placing blind actual leaks in geomembranes before performing an electrical leak location survey. The geomembranes can be bare (not covered) or can be covered with water or moist soil.

1.2 This guide is intended to serve as an additional quality control/quality assurance (QC/QA) measure to ensure that leaks through the geomembrane are detectable, site conditions are proper for leak location surveys, and a valid and complete leak location survey is performed. Because various leak location practitioners use a wide variety of equipment to perform these surveys and have a wide range of expertise, placement of blind actual leaks by the owner or owner's representative helps ensure that the leak location survey is being performed correctly and completely.

1.3 Placing blind actual leaks can also assist in determining whether or not the site conditions permit the flow of electric current through leaks, which is necessary for detecting leaks using electrical methods.

1.4 For clarification, this guide is in addition to the typical placement of the artificial or actual leaks placed as described in the relevant ASTM International standards for the various leak location methods.

1.5 Placing blind actual leaks should be done with the consent and knowledge of all involved parties and specifically the "owner" of the geomembrane. Geomembranes are typically purchased and installed by dedicated geosynthetic installers who "own" the geomembrane until the ownership gets transferred to the end user. A project meeting should be set up with the owner, the consultant, the geosynthetic installers, and the leak location contractor. The intention to use blind leaks should be clearly stated by the owner or consultants or both and the scope and number to be placed should be understood by all parties. The consultant should broadly identify to the lining contractor a location that can be easily repaired after the test. It is critical that all actual blind holes be included on the liner documentation and repair record drawing.

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 electrically insulating materials. (**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 earth 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 shall be taken to protect the leak location operators as well as other people at the site.)

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 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D4439 Terminology for Geosynthetics

D6747 Guide for Selection of Techniques for Electrical Detection of Leaks in Geomembranes

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

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

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.10 on Geomembranes.

Current edition approved March 1, 2014. Published March 2014. DOI: 10.1520/D7909–14

[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.

D7240 Practice for Leak Location using Geomembranes with an Insulating Layer in Intimate Contact with a Conductive Layer via Electrical Capacitance Technique (Conductive Geomembrane Spark Test)
D7703 Practice for Electrical Leak Location on Exposed Geomembranes Using the Water Lance System

3. Terminology

3.1 *Definitions:* For general definitions used in this guide, refer to Terminology D4439.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *artificial leak, n*—for the purposes of this guide, an artificial leak is an electrical simulation of a leak in a geomembrane during the leak detection sensitivity setup.

3.2.2 *blind actual leak, n*—for the purposes of this guide, a blind actual leak is a circular hole in the geomembrane intentionally placed by the owner or owner's representative to ensure that the site conditions are suitable for an electrical leak location survey and that a valid electric leak location survey is performed in a location unknown to the leak location practitioner.

3.2.2.1 *Discussion*—A blind actual leak is not a leak used to determine the leak detection sensitivity parameters.

3.2.3 *electrical leak location, n*—method that uses electrical current or electrical potential to detect and locate leaks in electrically isolating geomembranes.

3.2.4 *leak, n*—for the purposes of this guide, a leak is any unintended opening, perforation, breach, slit, tear, puncture, crack, or seam breach in electrically isolating geomembranes.

3.2.4.1 *Discussion*—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.

3.2.5 *leak detection sensitivity, n*—smallest size leak that the leak location equipment and survey methodology are capable of detecting under a given set of conditions.

3.2.5.1 *Discussion*—The leak detection sensitivity specification is usually stated as a diameter of the smallest leak that can be reliably detected.

4. Significance and Use

4.1 Geomembranes are used as low-permeability barriers to control 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 also erode the subgrade. 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 result even when the quality of the subgrade preparation, the quality of the material placed on the geomembrane, and the quality of the workmanship are not deficient.

4.3 Electrical leak location methods are an effective final quality assurance (QA) measure to locate previously undetected leaks in electrically insulating geomembranes. Practices for these implementations are contained in Guide D6747 and Practices D7002, D7007, D7240, and D7703.

4.4 It is important to realize that the detection of leaks depends not only on the capabilities of the leak location equipment, procedures, and experience of the leak location practitioner but also on local site conditions that are not under the control of the leak location practitioner. In particular, to detect a leak, there shall be an electrical conduction path through the leak and through the materials above and below the leak to allow sufficient electrical current through the leak for detection. For some site conditions, such as a leak not making contact with the subgrade, dry geotextile, or geocomposite above or below the leak; dry materials above or below the leak; degree of isolation between the materials above and below the geomembrane; and other factors, may preclude the detection of leaks. Therefore, the use of a properly placed blind actual leak is also a test of site preparations and conditions.

4.5 It is not necessarily proper to conclude that, if a blind actual leak is not detected, a leak location survey, using the proper relevant ASTM International standard, has no validity. Real leaks that have more favorable site conditions and larger leaks may still be detected.

4.6 The importance of blind actual leaks is to provide an additional measure to assess whether the site conditions are proper for a leak location survey and that the electric leak location survey is performed correctly and completely. The use of blind actual leaks provides: (*1*) a check that the equipment is operating properly, (*2*) a test for proper survey coverage, and (*3*) a check that all survey data (results) have been assessed to confirm a proper survey has been done. These all result in a high likelihood that significant-sized leaks are detected.

5. Procedural Guidance for Placement of Blind Actual Leaks

5.1 The fact that blind actual leak(s) will be installed in the geomembrane, and who will install the blind leak(s), who will survey the locations of the blind leak(s), and finally who will repair the blind actual leaks should be clearly described in the project specifications and understood by all affected parties so responsibilities and costs involved are fully understood by all affected parties. For the geomembrane leak location survey and use of blind actual leaks to be decisive, the project specifications should also specify the relevant ASTM International standard procedures to be used to perform the geomembrane leak location survey (see 2.1).

5.2 A realistic test of the leak detection sensitivity should be performed and documented as part of every leak location survey. The leak detection sensitivity of the leak location system via an actual or artificial leak is typically used according to the corresponding standard practices for the various leak location systems. The procedures for installing the actual leak holes for determining the leak detection sensitivity listed in the corresponding ASTM procedure can be used with the modifications described in 5.3 to place blind actual leaks.

5.3 The various electrical leak location practices all specify the use of actual leaks and procedures for making those actual leaks to determine the survey parameters and verify proper

system operation. Leak detection is dependent upon the site conditions at each leak. Site conditions that affect leak detection sensitivity (particularly for surveys with earth materials on the geomembrane, to some degree with surveys on bare geomembranes) include:

5.3.1 Having adequate moisture throughout the overburden material and near subgrade,

5.3.2 Moisture in the leak,

5.3.3 The presence of dry insulating materials such as geotextile or geonet in contact with the leak,

5.3.4 Contact of the geomembrane with the overburden and subgrade,

5.3.5 Degree of isolation of the overburden from earth ground or the conducting material under the geomembrane, and

5.3.6 The composition of the material in contact with the liner (large stones may bridge a leak).

5.4 Because of these varying site conditions, detecting a leak of the same size as the actual leak used to determine the leak detection sensitivity as specified in the ASTM International standards (see 2.1) could be problematic. Better leak detection sensitivity will be obtained at some locations, and worse leak detection sensitivity will be obtained at other locations. The specific guidelines for installing blind actual leaks are:

5.4.1 The preferred blind actual leaks are to be constructed by drilling a hole with a minimum diameter of 1.0 mm for exposed geomembranes (1.4 mm for a blind actual leak for a water covered leak detection survey and 6.4 mm for a blind actual leak for an earthen covered leak detection survey) that is to be tested at the time of geomembrane installation. The blind actual leaks shall be installed the same day as the geomembrane installation, and as early as practical before the geomembrane leak location survey is performed so that the blind test leak will be exposed to the same conditions of rainfall, condensation, consolidation, and equilibrium as the rest of the geomembrane in the installation. If the blind actual leaks cannot be installed the same day as during geomembrane placement and installation, the diameters of the blind actual leak shall be increased to twice the above-mentioned diameters. Specifically, the blind actual leak diameter would result into using a diameter of 12.8 mm for geomembranes that are to be covered with earth materials, 2.8 mm for geomembranes that are to be covered with water, and 2.0 mm for bare geomembranes.

5.4.2 For a double geomembrane system or underlying geosynthetic clay liner (GCL), procedures shall ensure that the drill bit does not damage the secondary geomembrane or GCL. The hole shall be drilled, and the drill bit moved forward and backward in the hole so the geomembrane material is removed rather than just displaced. (**Warning—**Because of the shock or electrocution hazard that may be involved with high voltage, do not attempt to drill the blind actual leak with the excitation power supply on or connected.)

5.4.3 The blind actual leaks are to be installed by the owner or a representative of the owner without revealing the locations to the leak location practitioner or others.

5.4.4 The locations of the blind actual leaks shall be documented using appropriate land-surveying methods so the blind actual leaks can be located for future repair.

5.4.5 The blind actual leaks shall be put in representative locations and not on wrinkles, areas of bridging, in fusion seams, or other areas where the geomembrane is not in contact with the subgrade. They should not be placed within 5 m of the edge of the survey area.

5.4.6 The blind actual leaks shall be backfilled with a compaction representative of the rest of the installation. Ensure that any cavity made by the drill in the subgrade under the blind actual leak is filled with soil.

5.4.7 The number of placed blind actual leaks should be consistent with the size and complexity of the overall installation, as well as with the purposes for which the blind actual leaks are installed. The owner or owner's representative should consider the cost of installing, surveying, documenting, and repairing the blind actual leaks and the fact that a repair weld or patch of inferior integrity will replace an otherwise intact geomembrane.

5.5 In summary, for the leak location survey to detect the intentionally placed blind actual leaks successfully, the blind actual leaks should have conductivity through the openings; otherwise, they may not be detected. If the owner or owner's representative has their own independent leak location equipment, the blind actual leaks could be verified as they are being placed.

5.6 As a courtesy to the leak location survey practitioner, the owner or owner's representative should mention at the start of the survey that a blind actual leak has been placed in accordance with this guide.

5.7 This guide is not a replacement of the existing ASTM procedures governing leak location surveys. In summary, all the leak location equipment, personnel, and procedures should demonstrate the ability to detect the actual or artificial leak before commencing the leak location survey as described in the relevant ASTM International standards (see 2.1).

6. Guidance if Blind Actual Leak is Detected

6.1 If the blind actual leak is detected, it should be treated as any other detected leak and the relevant ASTM standard practice should be followed including documenting and reporting and, whenever specified, testing for additional leaks in the near vicinity.

7. Guidance if Blind Actual Leak is Not Detected

7.1 If the leak location survey practitioner does not detect a blind actual leak after surveying an area where the blind actual leak was placed, then the owner or owner's representative should mention that a blind actual leak was not detected. The leak location survey practitioner shall review the survey data to determine if the blind actual leak signal is indicated in the survey data. If a leak signal is discernible in the data, all of the data should be reviewed to determine if any other leak signals were missed. In addition, the leak location practitioner and the representative of the owner shall confirm that the survey successfully completed the leak detection sensitivity tests per

the corresponding ASTM International procedure and that the survey was performed according to the ASTM International procedure.

7.2 If the blind actual leak was not detected (even after review of the survey data and confirming that the survey was performed properly per the relevant ASTM standard procedure) then the representative of the owner will show the leak location practitioner the position of the undetected blind actual leak and a leak location survey will be conducted to cover that area. If no leak signal is present in the repeat data, then the following potential conditions should be considered for each blind actual leak:

7.2.1 Subgrade restrictions (conductivity, moisture content, and so forth);

7.2.2 Proximity to survey boundary;

7.2.3 Geosynthetics underneath or above the geomembrane;

7.2.4 Uncovered material restrictions (waves, wrinkles, and so forth);

7.2.5 Cover material restrictions (conductivity, water saturation, and so forth);

7.2.6 Water requirement (depth necessary, quantity of water needed, bottom slope);

7.2.7 Proximity to protruding/penetrating accessories (pipes, steel bars, access platforms, ladders, concrete structure, and so forth). If so, the blind actual leak was not placed per the procedures of the relevant ASTM International standard;

7.2.8 The blind actual leak did not completely breach the thickness of the geomembrane; and

7.2.9 The blind actual leak was not in contact with the subgrade.

7.3 If it can be demonstrated that the blind actual leak was not detectable because of the considerations in 7.2.1 – 7.2.9 or other limitations and a detailed check with the leak location equipment shows that there is no electrical conductivity through the blind actual leak, then the blind actual leak (with its selected specific diameter) was, in fact, never detectable with that particular leak detection setup or site conditions. The cause of not being able to detect the blind leak should be investigated. If poor site conditions preclude the detection of the blind leak, then the site conditions should be modified in order to increase survey sensitivity. If modification of the site conditions enables detection of the blind leak, then the leak location survey should be repeated in any areas surveyed prior to modifying the site conditions. If it is determined that poor site conditions preclude the performance of a survey at the desired level of sensitivity and the site conditions cannot be altered, then the survey can nevertheless continue; however, with the knowledge that the desired level of sensitivity will be less than desired. In the extreme case where the site conditions preclude the performance of a survey on any size leak, such as a survey requested on non-conductive subgrade, then a leak location survey cannot be performed, and the failure to detect the blind actual leak does not indicate a shortcoming of the leak location survey. A report detailing the cause of the poor site conditions should be submitted in place of the leak location final report.

7.4 If the survey is ongoing for multiple days, it is recommended to review relevant ASTM International procedures to assure that the leak detection sensitivity test was implemented correctly. For example, the survey spacing could be optimized in accordance with relevant ASTM International standards (see 2.1). Alternatively, the size of the placed blind actual leak in the remainder of the survey can be increased to account for poor site conditions, with the exception where the site conditions preclude the performance of a survey altogether.

7.5 If it is deemed that the placed blind actual leak was not affected by the considerations in 7.2.1 – 7.2.9 or other limitations and the leak location practitioner cannot demonstrate functionality of the leak location equipment even though all components of the electrical leak path are proven to be sufficiently conductive for a survey and the survey is not affected by poor boundary conditions, then the blind actual leak was, in fact, never detectable with that particular leak detection equipment, and the failure to detect it indicates a shortcoming of the leak location practitioner. In that case, consideration should be given to repeating the leak location survey with different equipment or a different leak location practitioner, or both, until all actual blind leaks are successfully located. Responsibility for the cost of additional surveys will be in accordance with project contract requirements.

8. Keywords

8.1 artificial leak; blind actual leak; electrical leak location; geomembrane; leak detection; leak location