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Standard Practice for Non-destructive Testing (NDT) for Determining the Integrity of Seams Used in Joining Flexible Polymeric Sheet Geomembranes[1]

This standard is issued under the fixed designation D4437/D4437M; 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 intended for use as a summary of nondestructive quality control test methods for determining the integrity of seams used in the joining of flexible sheet materials in a geotechnical application. This practice outlines the test procedures available for determining the quality of bonded seams. Any one or combination of the test methods outlined in this practice can be incorporated into a project specification for quality control. These test methods are applicable to manufactured flexible polymeric membrane linings that are scrim reinforced or nonreinforced. This practice is not applicable to destructive testing. For destructive test methods look at other ASTM Standards and Practices.

1.2 The types of seams covered by this practice include the following: Thermally Bonded Seams, Hot Air, Hot Wedge (or Knife), Extrusion, Solvent Bonded Seams, Bodied Solvent Bonded Seams, Adhesive Bonded or Cemented Seams, Taped Seams, Waterproofed Sewn Seams.

1.3 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.4 *This standard may involve hazardous materials, operations, and equipment. 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]

D5641/D5641M Practice for Geomembrane Seam Evaluation by Vacuum Chamber

D5820 Practice for Pressurized Air Channel Evaluation of Dual Seamed Geomembranes

D6365 Practice for the Nondestructive Testing of Geomembrane Seams using the Spark Test

D7006 Practice for Ultrasonic Testing of Geomembranes

D7177/D7177M Specification for Air Channel Evaluation of Polyvinyl Chloride (PVC) Dual Track Seamed Geomembranes

3. Significance and Use

3.1 The use of geomembranes as barrier materials to restrict liquid migration from one location to another in soil and rock, and the large number of seam methods and types used in joining these geomembrane sheets, has created a need for standard tests by which the various seams can be compared and the quality of the seam systems can be non-destructively evaluated. This practice is intended to meet such a need.

3.2 The geomembrane sheet material shall be formulated from the appropriate polymers and compounding ingredients to form a plastic or elastomer sheet material that meets all specified requirements for the end use of the product. The sheet material (reinforced or nonreinforced) shall be capable of being bonded to itself by one of the methods described in 1.2 in accordance with the sheet manufacturer's recommendations and instructions.

[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.

4. Nondestructive Test Methods

4.1 For all test methods listed below, any and all flaws in seam construction that are detected under a given test procedure shall be repaired. All nondestructive test methods listed are not necessarily applicable to all polymeric geomembrane materials.

4.2 *Air Lance Test*—Inspect all seams for unbonded areas using an air nozzle directed on the upper seam edge and surface to detect loose edges, riffles indicating unbonded areas within the seam, or other undesirable seam conditions. Check all bonded seams using a minimum 50 psi [345 kPa] (gauge) air supply directed through a 3⁄16 in. [4.8 mm] (typical) nozzle, held not more than 2 in. [51 mm] from the seam edge and directed at the seam edge.

4.3 *Vacuum Box Testing*—Inspect all seams for unbonded areas by applying a vacuum to a soaped section of seam. The vacuum shall be applied by a vacuum box equipped with a vacuum gauge, a clear glass view panel in the top, and a soft rubber gasket on the periphery of the open bottom.[3] Thoroughly soap a section of the seam and place the inspection box over the soaped seam section and the gasket sealed to the liner. Apply a vacuum between 2 and 8 inches of mercury (Hg) (1 to 4 psi) to the box by use of a gasoline or electric-driven power vacuum pump apparatus. The applied vacuum will show bubbles over unbonded areas; the unbonded areas can then be marked for repair. See Practice D5641/D5641M.

4.4 *Ultrasonic (High Frequency) Pulse Echo Testing*—Test all non-reinforced seams by passing a high frequency sound wave through the seam overlap to detect discontinuities in the bonded seam. A commercially available frequency generator capable of producing frequencies in the range of 5 to 15 MHz shall be used. The contact send/receive transducer head shall be the width of the bonded seam width and shall be capable of being moved at the rate of 5 to 7 ft/min [1.5 to 2.1 m/min] along the surface length of the seam area. The transducer head shall be so designed as to give continuous surface to surface thickness measurements once calibrated. Assure good contact of the test head with the lining surface by providing a continuous contact medium (water) at the interface between test head and lining. The ultrasonic signal shall be capable of being viewed on a monitor and capable of triggering an audible alarm when a discontinuity is detected. Discontinuities shall be marked after detection. See Practice D7006.

4.5 *Mechanical Point Stressing*—This test method shall be used as a qualitative measure of edge bonding. A blunt instrument (for example, a screwdriver) shall be run along the edge of the seam to find obvious unbonded areas. The procedure shall not puncture or otherwise damage the sheet material. Perform point stressing only after the seam has had sufficient time to cure in accordance with manufacturer's directions. This test method is not applicable to all materials, especially those that are easily punctured.

4.6 *Pressurized Air Channel Evaluation of Dual Seam Geomembranes*—This test is applicable to dual track seams separated by an unwelded air channel. See Practice D5820. See Specification D7177/D7177M for PVC Geomembranes.

4.7 *Spark Test*—This test is applicable to seams made by extrusion method or seams where it is practical to insert a conductive material in the seam just prior to or during fabrication. See Practice D6365.

5. Report

5.1 The report shall include the following:

5.1.1 Complete identification of geomembrane system, including type of polymer, source, thickness, reinforced or nonreinforced sheeting,

5.1.2 Complete identification of seaming system used, including material, method, temperatures, seam width, cure time, and date of fabrication of seams,

5.1.3 Quality control test or tests used as outlined in this practice,

5.1.4 The type of nondestructive test and number of apparent failures and repairs per 100 ft [30.5 m] of seam.

6. Precision and Bias

6.1 No statement is made about either the precision or bias of this practice since it merely refers to available nondestructive methods which could be used in determining the quality of bonded seams.

[3] The sole source of supply of the apparatus (Series A 100 Straight Seam Tester) known to the committee at this time is the American Parts and Service Company, 2201 West Commonwealth Avenue, P.O. Box 702, Alhambra, CA 91802. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,[1] which you may attend.