



## Standard Practice for Geomembrane Seam Evaluation by Vacuum Chamber<sup>1</sup>

This standard is issued under the fixed designation D 5641; 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 reappraisal. A superscript epsilon (ε) indicates an editorial change since the last revision or reappraisal.

<sup>ε1</sup> NOTE—The title was corrected editorially in June 1995.

### 1. Scope

1.1 This practice covers procedures to perform nondestructive quality control testing described in Practice D 4437 and D 4545 for evaluating the continuity of all types of geomembrane seams using the bubble emission or vacuum chamber method.

1.2 The technique described in this practice is intended for use on geomembrane seams, patches, and defects.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units in parentheses are provided for information only.

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

### 2. Referenced Documents

#### 2.1 ASTM Standards:

D 4437 Practice for Determining the Integrity of Field Seams Used in Joining Polymeric Flexible Sheet Geomembranes<sup>2</sup>

D 4439 Terminology for Geotextiles<sup>2</sup>

D 4545 Practice for Determining the Integrity of Factory Seams Used in Joining Flexible Sheet Geomembranes<sup>2</sup>

E 515 Test Method for Leaks Using Bubble Emission Techniques<sup>3</sup>

#### 2.2 E.P.A. Documents:

EPA/600/2-88/052 Lining of Waste Containment and Other Impoundment Facilities, NTIS PB89-129-670<sup>4</sup>

EPA/530/SW-91/051 Inspection Techniques for the Fabrication of Geomembrane Field Seams<sup>4</sup>

### 3. Terminology

#### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *geomembrane, n*—an essentially impermeable geosynthetic composed of one or more synthetic sheets. (See

Terminology D 4439).

3.1.2 *seam, n*—the connection of two or more pieces of material by mechanical, chemical, or fusion methods to provide the integrity of a single piece of the material.

3.1.3 *vacuum chamber, n*—a device that allows a vacuum to be applied to a surface.

3.1.3.1 *Discussion*—In geomembranes, typical seams would include adhesive bonded, bodied chemical fusion welds; chemical fusion welds; dielectric; dual hot wedge; fillet extrusion; flat extrusion; hot air; single hot wedge; and ultrasonic. (See EPA/530/SW-91/051.)

NOTE 1—For definition of other terms used in this practice, refer to Terminology D 4439.

### 4. Summary of Practice

4.1 The basic principle of this practice consists of creating a pressure differential across a seam and observing for bubbles in a film of foaming solution over the low pressure side, within the vacuum chamber. The vacuum chamber has a viewing port that allows observation of the seam area being tested. The foaming solution is applied to the surface to be tested and the vacuum chamber is placed over the test area. As the chamber is held firmly in place, vacuum is applied. Air leakage through flaws in the test area cause bubbles in the foaming solution that may be observed.

### 5. Significance and Use

5.1 This practice is a nondestructive evaluation intended to be used for quality control purposes during factory or field seaming of geomembranes.

5.2 This practice may also be used to evaluate geomembrane panels for holes that penetrate the entire thickness of material. Limitations on the test practice are that it may not be suitable for uneven or curved surfaces, thick seams, seams in corners, and thin extensible geomembranes.

### 6. Apparatus

6.1 *Vacuum Pump*—The vacuum pump shall be fuel or electric powered and capable of sustaining the required vacuum for the duration of the test.

6.2 *Vacuum Gage*—The vacuum gage shall be capable of registering, as a minimum, to 70 kPa (10 psi) in increments of 5 kPa (¾ psi).

<sup>1</sup> This practice is under the jurisdiction of ASTM Committee D-35 on Geosynthetics and is the direct responsibility of Subcommittee D35.10 on Geomembranes. Current edition approved Nov. 15, 1994. Published January 1995.

<sup>2</sup> *Annual Book of ASTM Standards*, Vol 04.09.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 03.03.

<sup>4</sup> Available from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.

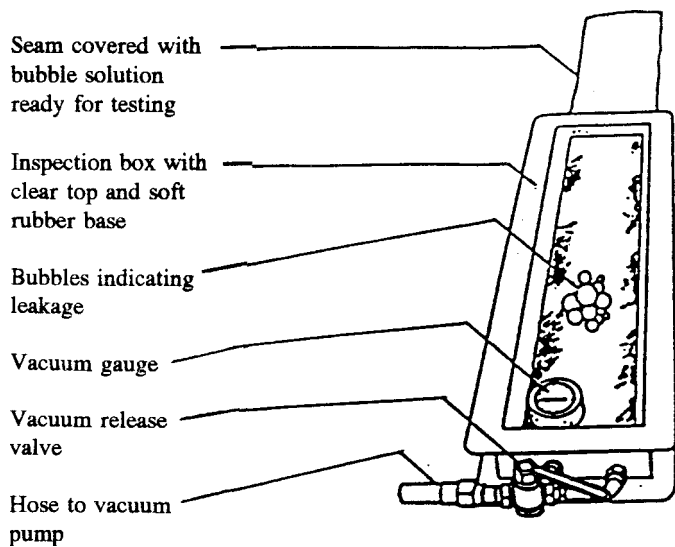


FIG. 1 Vacuum Chamber

6.3 *Calibration and Adjustment*—The calibration of the vacuum gage shall be checked and adjusted periodically, and routinely at a minimum of once every twelve months.

6.4 *Foaming Solution*—The foaming solution shall be pre-mixed with water at a ratio conducive to the formation of bubbles. It shall be dispensed by spray, brush, or any other convenient means. The foaming solution shall be compatible with the geomembrane.

NOTE 2—If the component to be tested has parts made of polyethylene or structural plastics, the test fluid must not promote environmental stress cracking (E.S.C.). (See Test Method E 515.)

6.5 *Vacuum Chamber*—The vacuum chamber shall have an open bottom and a clear viewing panel on top. It shall be an appropriate and convenient size and shape, made of rigid materials and equipped with a vacuum gage, valve, and soft pliable gasket around the periphery of the open bottom (see Fig. 1).

NOTE 3—Vacuum chamber equipment may be obtained from the suppliers given in Footnote 5.<sup>5</sup> These suppliers are cited only for convenience and no commercial endorsement is expressed or implied by incorporation into this practice.

**7. Procedure**

7.1 The area of the seam to be evaluated should be clean and free of soil or foreign objects that might prohibit a good seal from being formed between the vacuum chamber and the geomembrane.

7.2 Energize the vacuum pump.

<sup>5</sup> Series A100 Straight Seam Tester supplied by the American Parts and Service Company, 2201 West Commonwealth Avenue, P.O. Box 702, Alhambra, CA 91802. Vacuum Chamber Test System as supplied by Sinclair Equipment Company, 6686 A Merchandise Way, Diamond Springs, CA 95619. Columbine International, Ltd., 5441 Merchant Circle, Placerville, CA 95667.

7.3 Wet an area immediately adjacent to and including the geomembrane seam or test area measuring approximately twice the width and length of the vacuum chamber with a foaming solution.

7.4 Place the vacuum chamber over the wet area of the geomembrane such that the gasket is in complete contact with the geomembrane surface, and the test area is centered under the viewing port.

7.5 Apply a normal force to the top of the vacuum chamber to effect a seal and open the vacuum valve.

7.6 Ensure that a leak tight seal is created between the vacuum chamber gasket and the geomembrane material. For most cases, a minimum vacuum of 28 to 55 kPa (4 to 8 psi) as registered on the vacuum gage should be appropriate.

7.7 With the vacuum applied, maintain the normal force and observe the geomembrane seam or test area through the viewing port for bubbles resulting from the flow of air through defects in the seam. The vacuum should be held over the test site for a duration of not less than 10 s. If the vacuum cannot be held for the minimum 10 s, the test area shall be marked as untested. It is essential that the viewing port remain clean at all times to facilitate unobstructed viewing.

7.8 If bubbles appear on the geomembrane seam, turn the three-way vacuum valve to vent the chamber and remove the vacuum chamber from the seam. The defective area should then be marked for repair.

7.9 If bubbles do not appear through the geomembrane seam within the specified dwell time, turn the vacuum valve to vent the chamber and remove the chamber from the seam.

7.10 Move the vacuum chamber to the adjoining portion of the seam or test area overlapping the previously tested area by a distance no less than 10 % of the minimum chamber length or at least 50 mm (2 in.), whichever is the greater and repeat the procedure until the entire seam has been tested.

**8. Report**

8.1 Report the following information:

8.1.1 Identification of the geomembrane material, including type of polymer, source, thickness, reinforced or nonreinforced sheeting, seaming system used, ambient temperature, seam tested, seam width, date of seam fabrication, and date of seam evaluation, and results of seam evaluation,

NOTE 4—The intent of the form is not to imply that each VCT is to be recorded on said form.

8.1.2 Documentation of the typical vacuum pressure and hold duration and latest pressure gage calibrations,

8.1.3 Identification of the location and approximate size of all defective areas, and

8.1.4 Identification of foaming solution used for the test and if different types were used, the location of use for each type.

**9. Keywords**

9.1 bubble emission testing; geomembrane; nondestructive testing; seam; testing; vacuum; vacuum chamber

**APPENDIX**

(Nonmandatory Information)

**X1. Evaluation Form**

Testing Agency: \_\_\_\_\_  
 Date of Test: \_\_\_\_\_ Operator: \_\_\_\_\_  
 Project Name: \_\_\_\_\_  
 Installer: \_\_\_\_\_  
 Job Number: \_\_\_\_\_ Geomembrane Type: \_\_\_\_\_  
 Manufacturer: \_\_\_\_\_ Fabricator: \_\_\_\_\_  
 Seam Width: \_\_\_\_\_ Geomembrane Thickness: \_\_\_\_\_

SEAM      Factory \_\_\_\_\_      Field \_\_\_\_\_

Seam Type:    Single Hot Wedge \_\_\_\_\_    Dual Hot Wedge \_\_\_\_\_    Hot Air \_\_\_\_\_  
                  Flat Extrusion \_\_\_\_\_    Fillet Extrusion \_\_\_\_\_    Dielectric \_\_\_\_\_  
                  Chemical/Adhesive \_\_\_\_\_

Vacuum Gauge Calibration Date: \_\_\_\_\_

Weather: \_\_\_\_\_ Ambient Temp. \_\_\_\_\_

Seam Tested	Vacuum Applied	Hold Time Duration	Number of Defects Found	Number of Defects Repaired	Date Seam Accepted

Comments: \_\_\_\_\_

Seams Accepted By: \_\_\_\_\_

Date: \_\_\_\_\_

**FIG. X1.1 Evaluation Form**

*The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, are entirely their own responsibility.*

*This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, 100 Barr Harbor Drive, West Conshohocken, PA 19428.*

*This standard is copyrighted by ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (http://www.astm.org).*