



Standard Test Method for Tensile Strength of Geosynthetic Clay Liners¹

This standard is issued under the fixed designation D6768/D6768M; 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.

^{ε1} NOTE—Units information was corrected editorially in February 2015.

^{ε2} NOTE—Footnote 1 was corrected editorially in July 2015.

1. Scope

1.1 The test method establishes the procedures for the measurement of tensile strength of Geosynthetic Clay Liner (GCL). This test method is strictly an index test method to be used to verify the tensile strength of GCLs. Results from this test method should not be considered as an indication of actual or long-term performance of the geosynthetic(s) in field applications.

1.2 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.

1.3 *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

D76/D76M Specification for Tensile Testing Machines for Textiles

D123 Terminology Relating to Textiles

D2905 Practice for Statements on Number of Specimens for Textiles (Withdrawn 2008)³

D4439 Terminology for Geosynthetics

¹ This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.04 on Geosynthetic Clay Liners.

Current edition approved Jan. 15, 2015. Published February 2015. Originally approved in 2002. Last previous edition approved in 2009 as D6768–04 (2009). DOI: 10.1520/D6768_D6768M-04R15E02.

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.

³ The last approved version of this historical standard is referenced on www.astm.org.

D5889 Practice for Quality Control of Geosynthetic Clay Liners

D6072/D6072M Practice for Obtaining Samples of Geosynthetic Clay Liners

3. Terminology

3.1 *geosynthetic, n*—a product manufactured wholly or in part from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a project, structure, or system. **D4439**

3.2 *geosynthetic clay liner, n*—a manufactured hydraulic barrier consisting of clay bonded to a layer or layers of geosynthetic material(s).

3.3 For terminology of other terms used in this test method, refer to Terminologies D123 and D4439.

4. Summary of Test Method

4.1 A 100 mm [4-in.] wide specimen is gripped across its entire width in the clamps of a constant rate of extension (CRE) type tensile testing machine operated at a prescribed rate of extension, applying a longitudinal force to the specimen until the specimen ruptures.

5. Significance and Use

5.1 This test method may be used for the acceptance testing of commercial shipments of GCLs but caution is advised since information about between-laboratory precision is incomplete. Comparative tests as directed in 5.1.1 may be advisable.

5.1.1 In cases of a dispute arising from differences in reported test results when using this test method for acceptance of shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias. The two parties should take a group of test samples that are as homogeneous as possible and which are from the lot of material in question.

5.2 Some modification of clamping techniques may be necessary for a given GCL depending upon its structure. Specimen clamping may be modified as required at the discretion of the individual laboratory providing a representative tensile strength is obtained. In any event, the procedure

described in Section 10 of this test method for obtaining tensile strength must be maintained.

5.3 This test method is applicable for testing GCLs as received. It is used with a constant rate of extension type tension apparatus.

6. Apparatus

6.1 *Tensile Testing Machine*, a constant rate of extension (CRE) type of testing machine described in Specification **D76/D76M** shall be used with a minimum precision measuring capability of 0.1 N/m [5.71×10^{-4} lbf/in.].

6.2 *Clamps*, the clamps shall be a minimum 25 by 100 mm [1 by 4 in.] and with appropriate clamping power to prevent slipping or crushing (damage).

6.3 *Die or Template*, 100 by 200 mm (± 1 mm) [4 by 8 in. (± 0.04 in.)].

6.4 *Miscellaneous*, knives, razor, etc, as required.

7. Sampling and Test Specimens

7.1 *Lot Sample*—For the lot sample, take rolls of GCLs as directed in an applicable material specification, Practice **D5889**, or as agreed upon between the purchaser and the supplier.

7.2 *Laboratory Sample*—For the laboratory sample, sample shall be taken in accordance with Practice **D6072/D6072M**. The sample received at the testing laboratory should be in satisfactory condition and representative of the product manufactured or delivered to a site, or both.

7.3 *Test Specimens*—A minimum of five test specimens shall be taken in the machine direction from each swatch in the laboratory sample. Take specimens from the laboratory sample, with those for the measurement of the machine direction tensile properties from different positions across the GCL width. No specimens shall be taken within 10 cm [4 in.] of the selvage or edge of the GCL.

7.4 The size of the die or template for cutting specimens is 100 by 200 mm (minimum) [4 by 8 in.].

7.5 The loss of clay during the specimen cutting process should have no bearing on the results of the test.

8. Conditioning

8.1 The test specimen shall be tested as received.

9. Procedure

9.1 *Obtain Specimens*—Using the die, or template and razor, and other necessary apparatus, carefully cut from the laboratory sample five (5) test specimens. The five specimens should be randomly selected from locations on the sample, but should be distributed across the sample. All specimens should be cut parallel to the machine direction.

9.2 *Machine Set-Up Conditions*—Adjust the distance between the clamps at the start of the test to 100 ± 3 mm [4 ± 0.1 in.]. Set the CRE at 300 mm/min [12 in./min].

9.3 *Insertion of Specimen in Clamps*—Mount the specimen centrally in the clamps. The specimen must be visually

observed 25 mm [1 in.] extend past the clamp. The specimen length in the machine direction must be parallel to the direction of application of force.

9.4 *Measurement of Tensile Strength*—Start the tensile testing machine.

9.4.1 Continue testing the specimen until complete rupture and record the maximum tensile force of the GCL.

9.4.2 Readings of force and time shall be taken at a minimum rate of 20 readings per second.

9.4.3 If a specimen slips in the jaws, or if for any reason attributable to faulty operation the results fall significantly below the average for the set of specimens, discard the results and test another specimen. Continue until the required number of readings has been taken.

10. Calculation

10.1 *Tensile Strength*—Calculate the tensile strength as read directly from the test instrument expressed in N/m [lbf/in.] of width, using the following equation:

$$\alpha_{fn} = \frac{(\alpha_{f1} + \alpha_{f2} + \dots + \alpha_{fs})}{5}$$

$$\alpha = \frac{\alpha_{fn}}{W_s}$$

where:

α_{fn} = average recorded peak tensile strength for specimen, N [lbf],

α = tensile strength of the GCL, N/m [lbf/in.], and

W_s = specified specimen width, m [in.].

11. Report

11.1 Report the following information on tensile strength of GCLs.

11.1.1 All specimen values and average peak tensile strength/unit width to the nearest 0.1 N/m [lbf/in.].

11.1.2 If requested, the standard deviation, coefficient of variation, or both.

11.1.3 Sample identification (for example, sample no., roll no., or other traceable identifier).

11.1.4 Type of GCL tested.

11.1.5 Type of testing machine and upper limit of load.

11.1.6 Full scale force range used for testing.

11.1.7 A statement of any departure from the suggested testing procedures so that the results can be evaluated and used.

11.1.8 Note any cause or need for testing additional specimens due to rupture of the geotextile(s) during test, damage to specimen from the grips, etc.

11.2 Identification of testing agency, person performing the test, date of test and client or project identification.

11.3 Verification that the rupture of the GCL occurred.

12. Precision and Bias

12.1 *Interlaboratory Test Program*—An interlaboratory study of the test method was run in 2002/2003. Four different geosynthetic clay liner samples were distributed to ten laboratories. Three sets of test results were generated for each sample by each of the laboratories.

12.2 *Test Results*—The precision information is given in **Table 1**. The results are presented for the average of the

TABLE 1 Test Results

Statistic	ILS Average
Within laboratory repeatability limit, CVSr, %	4
Between laboratory reproducibility limit, CVSR, %	8
95 % confidence limit within laboratory repeatability, CVr, %	10
95 % confidence limit between laboratory repeatability, CVr, %	23

coefficient of variation, CV%, for the four samples.

12.3 *Bias*—The procedure in Test Method D6768 for measuring the tensile strength of the geosynthetic clay liner has no bias because the value of the tensile strength of a geosynthetic clay liner is defined only in the terms of this test method.

13. Keywords

13.1 clay; geosynthetic; geosynthetic clay liner; tensile strength

ASTM International 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 International 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, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, 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 (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>