



Standard Test Method for Measuring the Nominal Thickness of Geosynthetics¹

This standard is issued under the fixed designation D5199; 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.

1. Scope

1.1 This test method covers the measurement of the nominal thickness of geosynthetics, except textured and some structured geomembranes where the entire surface of the presser foot cannot come into complete contact with the geosynthetic surface.

1.2 This test method does not provide thickness values for geosynthetics under variable normal compressive stresses. This test method determines nominal thickness, not necessarily minimum thickness.

1.3 The values stated in SI units are to be regarded as standard. The values given in parentheses are 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:*²

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

D2905 Practice for Statements on Number of Specimens for Textiles (Withdrawn 2008)³

D4354 Practice for Sampling of Geosynthetics and Rolled Erosion Control Products(RECPs) for Testing

D4439 Terminology for Geosynthetics

D5199 Test Method for Measuring the Nominal Thickness of Geosynthetics

D5994 Test Method for Measuring Core Thickness of Textured Geomembranes

¹ This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.03 on Permeability and Filtration.

Current edition approved Feb. 1, 2012. Published February 2012. Originally approved in 1991. Last previous edition approved in 2011 as D5199 – 11. DOI: 10.1520/D5199-12.

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.

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

3. Terminology

3.1 For definitions of other terms relating to geotextiles and geomembranes used in this standard, refer to Terminology D4439. For definition of other textile terms used in this standard, refer to Terminology D123.

3.2 *Definitions:*

3.2.1 *pressure, n*—the force or load per unit area.

3.2.2 *thickness*—(1) the distance between one planar surface and its opposite parallel and planar surface; (2) in the textiles the distance between the upper and lower surfaces of the material, measured under a specified pressure and time.

3.2.3 *structured geomembrane, n*—geomembrane consisting of a flat core and protrusions on one or both sides 3.1.3 For definitions of other terms relating to geotextiles and geomembranes used in this standard, refer to Terminology D4439.

4. Summary of Test Method

4.1 The nominal thickness of geosynthetics is determined by observing the distance between two parallel surfaces confining the tested material while under a specified pressure, after 5 seconds.

5. Significance and Use

5.1 Thickness is one of the basic physical properties used to control the quality of many geosynthetics. Thickness values can be required for calculation of some geosynthetics properties such as permeability and tensile stress, among others.

5.2 The thickness of some geosynthetics may vary considerably with the applied normal load. Specific pressures and surfaces on which they are applied are indicated in this method to ensure all results are comparable.

5.3 This test method may be used for acceptance testing of commercial shipments of geosynthetics for which this method is applicable (see 1.1).

NOTE 1—The user should be aware that the compressibility of some materials, their rebound characteristics, and other phenomenon will affect the thickness of some geosynthetics, following the time when they are rolled up, shipped and stored.

6. Apparatus

6.1 *Thickness Testing Instrument*—The thickness gauge shall have a base (or anvil) and a free moving presser foot plate whose planar faces are parallel to each other to <0.01 mm. A gauge with a 56.4 mm (2.22 in.) diameter presser foot, the base shall extend at least 10 mm (3/8 in) in all directions further than the edge of the 2500 mm² (3.88 in²) circular presser foot, shall be used for measurements of geotextiles, geocomposite drainage materials, and geonets. A gauge with a 6.35 mm (0.250 in.) diameter presser foot and a base at least 6.35 mm (0.250 in) diameter shall be used for geomembranes. The instruments must be capable of measuring a maximum thickness of at least 10 mm (3/8 in) to an accuracy of at least ± 0.02 mm (± 0.0008 in.). The gauges shall be constructed to permit gradual application of pressure to a specific force of 2 ± 0.02 kPa (0.29 ± 0.003 psi) for geotextiles and 20 ± 0.2 kPa (2.9 ± 0.03 psi) for geomembranes. Dead-weight loading may be used.

6.1.1 The specified pressure of 2 or 20 kPa may not be sufficient to flatten some stiff geosynthetics. For these products, usage of a frame pressing firmly the outer edge of the specimen on the base of the thickness testing instrument can be used, to ensure full contact of both the pressure foot and the base on the specimen in the area of interest. However, care shall be given to avoid influencing the measurement, i.e. by applying some stress on the sample under the pressure foot.

NOTE 2—For HDPE geomembrane only, a pressure within a range of 50 to 200 kPa can be used in place of, or in conjunction with the frame described in 6.1.1

NOTE 3—Due to the compressibility of some types of geosynthetics, cutting and handling may influence the measurements. Care should be exercised to minimize these effects.

7. Sampling

7.1 *Lot Sample*—In the absence of other guidelines divide the product into lots and take lot samples as specified in Practice D4354.

7.2 *Laboratory Sample*—Consider the units in the lot sample as the units in the laboratory sample. For the laboratory sample, take a full width sample of sufficient length along the selvage or edge of the roll so that the requirements of 7.3 – 7.5 can be met. Exclude the inner and outer wraps of the roll or any material containing folds, crushed areas or other distortions not representative of the sampled lot.

7.3 Remove test specimens from the laboratory sample in a randomly distributed pattern across the width with no specimen taken nearer than 100 mm (4 in.) from the selvage or roll edge, unless otherwise specified. For geomembranes, include at least one specimen taken no more than 152 mm (6 in.) from the edge, in the area which is likely to be welded.

7.4 *Test Specimens*—From each unit in the laboratory sample, remove the specimens so that the edge of the specimen will extend beyond the edge of the presser foot by 10 mm (0.39 in.) in all directions. If a frame is found to be necessary to flatten stiff geosynthetics, the dimension of the specimen shall be adapted to ensure that usage of the frame will not influence the measurement.

7.5 *Number of Specimens*—Unless otherwise agreed upon, thickness measurements shall be conducted on 10 specimens spread across the full width of the roll.

8. Conditioning

8.1 Bring the specimens to moisture equilibrium in the atmosphere for testing geotextiles and geomembranes, that is, temperature of $21 \pm 2^\circ\text{C}$ ($70 \pm 4^\circ\text{F}$) and relative humidity of 60 ± 10 %.

8.2 Moisture equilibrium is considered to have been reached when the change in mass of the specimen, in successive weightings made at intervals of not less than 2 h, does not exceed 0.1 % of the mass of the specimen.

NOTE 4—It is recognized that in practice, a conditioning of 24 hours is sufficient to reach equilibrium for geotextiles and geomembranes which do not exhibit excessive moisture on reception. However, in case of dispute, the method described in 8.2 shall be preferred.

9. Procedure

9.1 Test the conditioned specimens in the standard atmosphere specified in 8.1.

9.2 Handle the test specimens carefully to avoid altering the natural state of the material. In particular, no tension shall be exerted in the plane of geotextiles or other easily deformable products.

9.3 *Procedure A - Geotextiles, planar geocomposite drainage materials, and geonets:* With the force applied to the presser foot on the base (no test specimen present), zero the measuring scale or record the “base reading.” Lift the presser foot, center the test specimen on the base under the presser foot, and bring the presser foot into contact with the material. Gradually increase the pressure to 2 kPa (0.29 psi). After the full force has been applied to presser foot for 5 s against the specimen, record the thickness value to the nearest 0.02 mm and remove the specimen from the test device.

9.4 *Procedure B - All geomembranes excluding textured or structured geomembranes:* With the force applied to the presser foot on the base (no test specimen present), zero the measuring scale or record the “base reading.” Lift the presser foot, center the specimen on the base under the presser foot, and bring the presser foot into contact with the material. Gradually increase the pressure to 20 kPa (2.9 psi). After the full force has been applied to presser foot for 5 s against the specimen, record the thickness value to the nearest 0.02 mm and remove the specimen from the test device.

NOTE 5—For textured or structured geomembranes, use ASTM D5994

9.5 *Procedure C -* This method involves test conditions (presser foot diameter, applied pressure) agreed upon by the parties. It can be used only for products which cannot be evaluated per procedures A or B, or for research and development. With the force applied to the presser foot on the base (no test specimen present), zero the measuring scale or record the “base reading.” Lift the presser foot, center the specimen on the base under the presser foot, and bring the presser foot into contact with the material. Gradually increase the pressure to the agreed-upon pressure. After the full force has been applied to presser foot for 5 s against the specimen, record the

Procedure	Applicable for testing of:	Diameter of the pressure foot	Pressure applied (5 seconds)
A	Geotextiles, planar drainage geocomposites, geonets for which this method is applicable (see 1.1)	56.4 mm (2.22 in.)	2 kPa (0.29 psi)
B	All geomembranes for which this method is applicable (see 1.1)	6.35 mm (0.25 in.)	20 kPa (2.9 psi)
C	Products not listed above (excluding textured geomembranes)	Either 6.35 mm or 56.4 mm as agreed upon by the parties	Either 2 or 20 kPa as agreed upon by the parties

thickness value to the nearest 0.02 mm and remove the specimen from the test device.

10. Calculation

10.1 Calculate the average of the thickness for all test results as read directly from the test instrument, as well as the coefficient of variation.

11. Report

11.1 The report for the nominal thickness shall include the following information:

11.1.1 Project, type of geotextile or geomembrane tested, and method of sampling.

11.1.2 Name or description of thickness apparatus used for testing.

11.1.3 Dimensions of the specimen.

11.1.4 Procedure used (A, B or C) as well as the diameter of the presser foot and the applied pressure.

11.1.5 Average nominal thickness, and

11.1.6 Coefficient of variation of thickness in the sample, in percent (optional).

11.1.7 Any unusual or out of standard conditions or observations made during the tests.

11.1.8 Any deviation from this procedure.

12. Precision and Bias

12.1 *Precision (Geotextiles):*

12.1.1 *Inter-Laboratory Test Program*⁴—An inter-laboratory study of Test Method **D5199** was performed in 1994. Each of six laboratories tested ten randomly drawn specimens from each of four materials.

12.1.2 *Result*—The precision information given below has been calculated for the comparison of six test results, each of which is the average of ten specimens. Four different materials were tested.

12.1.3 *95 % Repeatability Limit*—The repeatability limit is 14 % of the test results. For the different materials, the repeatability limits range from 22 % to 9 %.

12.1.4 *95 % Reproducibility Limit (Between Laboratory)*—The reproducibility limit is 23 % of the test results. For the different materials, the repeatability limits range from 33 % to 17 %.

12.1.5 The respective coefficients of variation percentages for the test results may be obtained by dividing the above numbers by 2.8. Hence, for the four materials tested:

Repeatability	Reproducibility
Material A—8 %	Material A—12 %
Material B—4 %	Material B— 8 %
Material C—3 %	Material C— 7 %
Material D—5 %	Material D— 6 %

12.2 *Precision (Smooth Surfaced Geomembranes):*

12.2.1 *Inter-Laboratory Test Program*⁴—An inter-laboratory study of Test Method **D5199** was performed in 1994. Each of three laboratories tested ten randomly drawn specimens from each of four materials.

12.2.2 *Result*—The precision information given below has been calculated for the comparison of three test results, each of which is the average of ten specimens. Four different materials were tested.

12.2.3 *95 % Repeatability Limit*—The repeatability limit is 5 % of the test results. For the different materials, the repeatability limits range from 8 % to 2 %.

12.2.4 *95 % Reproducibility Limit (Between Laboratory)*—The reproducibility limit is 12 % of the test results. For the different materials, the repeatability limits range from 18 % to 8 %.

12.2.5 The respective coefficients of variation percentages for the test results may be obtained by dividing the above numbers by 2.8. Hence, for the four materials tested:

Repeatability	Reproducibility
Material A—1 %	Material A—4 %
Material B—1 %	Material B—7 %
Material C—3 %	Material C—3 %
Material D—2 %	Material D—4 %

12.3 *Precision (Geonet and Geocomposite):*

12.3.1 *Inter-Laboratory Test Program*—An inter-laboratory study of Test Method **D5199** was performed in 1999. Three sets (ten test specimens each) which were randomly drawn from each material, one geonet and one double-sided geocomposite, that were tested for thickness in each of the five laboratories. The design of the experiment, similar to that of Practice **E691**, and a within-between analysis of the data are given in an ASTM Research Report.⁵

⁴ The design of the experiment, similar to that of Practice **E691**, and a within-between analyzer of the data will be available.

⁵ Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D35-1009.

12.3.2 *Test Result*—The precision information is given below. The precision values are for the thickness test results and are in terms of coefficients of variation, CV%.

12.3.3 *Precision:*

Statistic	Geonet	Geocomposite
Average thickness, mm	5.64	6.98
Within-laboratory repeatability limit, CV% _r	1.6 %	1.0 %
Between-laboratory reproducibility limit, CV% _R	3.9 %	1.6 %
95 % confidence limit, within-laboratory repeatability, 2.8 CV% _r	4.4 %	3.0 %
95 % confidence limit, within-laboratory reproducibility, 2.8 CV% _R	10.8 %	4.3 %

12.4 *Bias*—The procedure in this test method has no bias because the value of that property can only be defined in terms of the test method.

13. Keywords

13.1 sample; selvage; specimen

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/