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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 reapproval. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reapproval.

1. Scope

~~1.1 This test method covers the measurement of the nominal thickness of geotextiles, smooth surfaced geomembranes, geonets, and geocomposite drainage products.~~

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~~

[D1776 Practice for Conditioning and Testing Textiles](#)

D2905 [Practice for Statements on Number of Specimens for Textiles](#)

D4354 [Practice for Sampling of Geosynthetics 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](#)

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 thicknesses of geosynthetics is determined by observing the perpendicular distance that a movable plane is displaced from a parallel surface by the geotextile or geomembrane material while under a specified pressure (2 kPa for geotextiles and 20 kPa for geomembranes for 5 s).~~

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.

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.

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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.

5. Significance and Use

5.1 Thickness is one of the basic physical properties used to control the quality of many geosynthetics. Thickness values are required in calculation of some geotextile and geomembrane parameters such as permeability coefficients, tensile stress (index), and the like thickness is not indicative of field performance and therefore is not recommended for specifications.

5.2 The thickness of geotextiles and geomembranes may vary considerably depending on the pressure applied to the specimen during measurement. Where observed changes occur, thickness decreases when applied pressure is increased. To minimize variation, specific sample size and applied pressure are indicated in this method to ensure all results are comparable.

5.3 To determine the effect of difference pressure loadings on the measure thickness of geotextiles and geomembranes, use this test method.

5.4 This test method may be used for acceptance testing of commercial shipments of geotextiles and geomembranes, but caution is advised since information on between-laboratory precision is incomplete. Comparative tests, as directed in 5.4.1 may be advisable.

5.4.1 In case of a dispute arising from differences in reported test results when using this test method for acceptance testing of commercial shipments, the purchaser and the supplier should conduct comparative tests to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are formed from a lot of material of the type in question. The test specimens should be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before the testing is begun. If bias is found, either its cause must be found and corrected or the purchaser and supplier must agree to interpret future tests in the light of the known bias.

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 the some materials, their rebound characteristics, and the like other phenomenon will also affect the thickness of the geotextiles and geomembranes some geosynthetics, following the time when they are rolled up on rolls 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 circular pressor foot, shall be used for measurements of geotextiles, geocomposite drainage materials, and geonets. A gauge with a 6.35 mm (0.250 in.) diameter pressor foot shall be used for laboratory measurements of geomembranes. A gauge with 6.35 mm (0.250 in.) diameter pressor foot and base may be used for field measurements of geomembrane thickness. The instruments must be capable of measuring a maximum thickness of at least 10 mm to an accuracy of at least ± 0.02 mm. 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 force of 20 kPa may be inadequate for some HDPE geomembranes. A pressure in the range of 50 to 200 kPa is recommended for HDPE geomembranes if fictitiously high readings are suspected using the 20 kPa pressure. (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—(Appendix X1) lists some of the suppliers of apparatus for thickness measurement.

6.2 *Cutting Dies*—Dies to cut specimens should have dimensions at least as large as a circle of 75 mm (3 in.) diameter. 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 compressibility of many geotextiles and geomembranes the cutting and handling preparation may change the thickness. Care should be exercised to minimize these effects. 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 7.3-7.5.2-7.3-7.5 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. Since seams are an important part of geomembrane applications, thickness readings within 152 mm (6 in.) of each edge is appropriate. 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 pressor foot by 10 mm (0.39 in.) in all directions (that is, at least a circle of 75 mm (3 in.) in diameter).—From each unit in the laboratory sample, remove the specimens so that the edge of the specimen will extend beyond the edge of the pressor 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, as when provided in an applicable material specifications, take a number of test specimens per laboratory sample such that the user may expect at the 95% probability level that the test result is not more than 6.0% of the average above or below the true average of the sample. Determine the number of specimens per sample as follows:

7.5.1 *Reliable Estimate of v* —When there is a reliable estimate of v based upon extensive part records for similar materials tested in the user's laboratory as directed in the method, calculate the required number of specimens for the machine and cross-machine directions as follows:

$$n = (tv/A)^2 D5199-11-1$$

where:

n = number of test specimens (rounded upward to a whole number),

v = reliable estimate of the coefficient of variation of individual observations on similar materials in the user's laboratory under conditions of single-operation precision, %;

t = the value of Student's t for two-sided limits (see Table 1), a 95% probability level, and the degrees of freedom associated with the estimate of v , and

7.5.2 *Reliable Estimate of v* —When the value of the reliable estimate of v for the user's laboratory, Eq 1 should not be used directly. Instead, specify the fixed number (10) of specimens. The number of specimens is calculated using $v=9.5\%$ of the average. These values for v are somewhat larger than usually found in practice. When a reliable estimate of v for the user's laboratory becomes available, Eq 1 will usually require fewer than the fixed 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 $60 \pm 10\%$.

8.2 *Moisture Equilibrium* is considered to have been reached when the increase in mass of the specimen, in successive weighings made at intervals of not less than 2 h, does not exceed 0.1% of the mass of the specimen. In general, many geotextiles and geomembranes contain more moisture when received than they will after reaching moisture equilibrium.

8.2 *Moisture equilibrium* is considered to have been reached when the change in mass of the specimen, in successive weighings 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, geotextiles and geomembranes are frequently not weighed to determine when moisture equilibrium has been reached. While such a method cannot be accepted in cases of dispute, it may be sufficient in routine testing for a reasonable period of time before the specimens are tested. A time of at least 24 h has been found acceptable in most cases. However, fibers may contain more moisture upon receipt than after conditioning and lose moisture relatively slowly during conditioning. When this is known, a preconditioning cycle, as described in Practice D1776, may be agreed upon by the contractual parties for routine testing. 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.*

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, Gplanar geocomposite-D drainage-M materials, and Geonets:geonets:* With the force applied