



Designation: D4594/D4594M – 96 (Reapproved 2020)

# Standard Test Method for Effects of Temperature on Stability of Geotextiles<sup>1</sup>

This standard is issued under the fixed designation D4594/D4594M; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This test method provides a procedure for determining the effects of climatic temperature on the tensile strength and elongation properties of geotextiles.

1.2 The effect of temperature on the stability of geotextiles is reported as the change in tensile strength and elongation between tests performed as directed in Test Method D5035, in the standard atmosphere for testing textiles, and tests performed under conditions at which the geotextile is expected to perform in the field.

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 are not necessarily exact equivalents; therefore, to ensure conformance with the standard, each system shall be used independently of the other, and values from the two systems shall not be combined.

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, health, and environmental practices and determine the applicability of regulatory limitations prior to use. See 7.1.1 – 7.1.3.*

1.5 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

D76/D76M Specification for Tensile Testing Machines for Textiles

D123 Terminology Relating to Textiles

D1682 Test Method for Breaking Load and Elongation of Textile Fabric (Withdrawn 1992)<sup>3</sup>

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

D4439 Terminology for Geosynthetics

D5035 Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method)

## 3. Terminology

3.1 *Definitions:*

3.1.1 *atmosphere for testing geotextiles, n*—air maintained at relative humidity of 50 to 70 % and at a temperature of  $21 \pm 2$  °C [ $70 \pm 4$  °F].

3.1.2 *temperature stability, n*—for a geotextile, the percent change in tensile strength or in percent elongation as measured at a specified temperature and compared to values obtained at the standard conditions for testing geotextiles.

3.2 For definitions of other terms used in this test method, refer to Terminology D123 and Terminology D4439.

## 4. Summary of Test Method

4.1 Specimens of a geotextile are conditioned at selected temperatures in an environmental chamber attached to a tensile testing machine. While maintaining these temperatures, 50.8 mm [2 in.] cut or ravel strip tensile tests are performed as directed in Test Method D5035. The same tests are conducted as control under the standard laboratory test conditions. Tensile strength and percent elongation properties obtained at various test temperatures are recorded. Changes in strength characteristics due to the effects of temperature are determined.

4.2 The temperatures used for conditioning and testing the geotextiles are the temperatures at which the geotextile will perform or are typically exposed to in the field.

## 5. Significance and Use

5.1 This test method is used for evaluating the relative effects of temperature on geotextiles manufactured from different polymers, by a different manufacturing process, or both.

<sup>3</sup> The last approved version of this historical standard is referenced on [www.astm.org](http://www.astm.org).

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.02 on Endurance Properties.

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<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](http://www.astm.org), or contact ASTM Customer Service at [service@astm.org](mailto:service@astm.org). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

5.2 During shipping and storage, the geotextile may be exposed to abnormal temperatures. The fabric could be tested at these temperatures to determine the detrimental effects of these conditions on the strength properties.

5.3 This test method may also be used to evaluate the cyclic effects of temperature (freeze-thaw); that is, samples can be conditioned to below normal temperatures (below freezing) and then to above normal temperatures (elevated temperatures) for a given number of cycles. Strength characteristics can be determined after these cyclic exposures.

5.4 Most nonwoven, woven, and composite fabric can be tested by this method. Modification of the techniques is likely to be necessary for any fabric having a strength in excess of 179 kg/cm [1000 lb/in.] width. This test method is not recommended for knitted fabrics.

5.5 This test method is an index test method and is not recommended for acceptance testing of commercial shipments, since information on between-laboratory precision has not been established. In some cases the purchaser and seller may have to test a commercial shipment of one or more geotextiles by the best available method, even though the method has not been recommended for acceptance testing of commercial shipments. A comparative test performed as directed in 5.5.1 may be advisable.

5.5.1 In case of a dispute arising from differences in reported test results when using Test Method D4594/D4594M 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 homogenous as possible and that are from a lot of material of the type in question. The test specimens should then 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 a bias is found, either its cause must be found and corrected or the purchaser and the supplier must agree to interpret future test results in the light of the known bias.

## 6. Apparatus

6.1 *Tensile Testing Machine*, of the constant-rate-of-extension (CRE) or constant-rate-of-traverse type, with automatic recorder conforming to the requirement of Specification D76/D76M.

6.2 *Environmental Chamber*, capable of maintaining a temperature range from  $-40$  to  $+100$  °C [ $-40$  to  $+212$  °F] and equipped with temperature regulation capable of maintaining the test temperature within  $\pm 2$  °C [ $\pm 4$  °F] inside the chamber.

6.3 *Various Tubing and Fittings*, to hook up the gas to the environmental chamber.

6.4 *Thermometer*, capable of measuring the temperature range within which tests are being performed and graduated in a 1 °C [2 °F] division scale.

## 7. Materials

7.1 *Liquid Nitrogen*, commercial grade or any other dry medium capable of producing temperatures below 0 °C [32 °F].

7.1.1 (**Warning**—Since liquid nitrogen is a cryogenic liquid which produces extremely low temperatures when vented to the atmosphere, keep hands clear of open valves and tubings, etc. During testing, use insulated leather gloves to handle samples and to open and close the environmental chamber door. The laboratory should be well ventilated.)

7.1.2 Other gases which can be used are helium  $-167$  °C [ $-269$  °F], oxygen  $-119$  °C [ $-183$  °F], argon  $-121$  °C [ $-186$  °F], and carbon dioxide  $-62$  °C [ $-79$  °F]. Temperature values listed are the minimum temperatures these gases can attain.

7.1.3 The use of liquid nitrogen is suggested for the test. Nitrogen is less hazardous, more economical than other gases, and also capable of attaining a minimum temperature of  $-127$  °C [ $-196$  °F]. Oxygen, being a strong oxidizer, should be avoided if possible; otherwise, use cautiously in a well-ventilated area away from open flame.

## 8. Sampling

8.1 *Division into Lots and Lot Sample*—Unless otherwise agreed upon as in an applicable material specification, divide the material into lots and take a lot sample as directed in Practice D4354. Consider rolls of fabric to be the primary sampling units.

8.2 *Laboratory Sample*—Take for the laboratory sample a swatch extending the width of the fabric and approximately 1 m [1 yd] along the selvage from each roll in the lot sample. The swatch may be taken from the end portion of a roll provided there is no evidence that it is distorted or different from other portions of the roll. In cases of dispute, take a swatch that will exclude fabric from the outer wrap of the roll or the inner wrap around the core.

8.3 *Test Specimens*—For the standard conditions and for each test temperature to which the geotextile is to be exposed, cut five specimens at least 50.8 mm [2 in.] wide by 152.4 mm [6 in.] long from each swatch in the laboratory sample with the long dimension of the specimens parallel to the lengthwise direction. Cut five specimens of the same size from each swatch in the laboratory sample with the long dimension of the specimen parallel to the widthwise direction. Prepare the specimens as directed in Test Method D5035 for ravelled strip test, cut strip test, or both.

## 9. Test Setup

9.1 Disconnect the jaw clamps from the tensile testing machine.

9.2 Insert the environmental chamber between cross heads of the machine. Secure firmly to the machine. Connect the jaw clamp back to the machine from inside the chamber.

9.3 Connect the environmental chamber to the liquid nitrogen cylinder, or any other dry medium, and to AC outlet as per manufacturer's instructions (see 7.1.1 – 7.1.3).