Designation: D4595/D4595M – 24

Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Method[1]

This standard is issued under the fixed designation D4595/D4595M; 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 tensile properties of geotextiles using a wide-width specimen tensile method. This test method is applicable to most geotextiles that include woven geotextiles, nonwoven geotextiles, layered fabrics, and knit fabrics that are used for geotextile applications.

1.2 This test method covers the measurement of tensile strength and elongation of geotextiles and includes directions for the calculation of initial modulus, offset modulus, secant modulus, and breaking toughness.

1.3 Procedures for measuring the tensile properties of both conditioned and wet geotextiles by the wide-width method are included.

1.4 The basic distinction between this test method and other methods for measuring strip tensile properties is the width of the specimen. Some fabrics used in geotextile applications have a tendency to contract (neck down) under a force in the gage length area. The greater width of the specimen specified in this test method minimizes the contraction effect of those fabrics and provides a closer relationship to expected geotextile behavior in the field and a standard comparison.

1.5 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 nonconformance with the standard.

1.6 *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.*

1.7 *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:*[2]

D76/D76M Specification for Tensile Testing Machines for Textiles

D579/D579M Practice for Greige Woven Glass Fabrics

D1776/D1776M Practice for Conditioning and Testing Textiles

D2905 Practice for Statements on Number of Specimens for Textiles (Withdrawn 2008)[3]

D4439 Terminology for Geosynthetics

D4873/D4873M Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples

D8102 Practice for Manufacturing Quality Control of Geotextiles

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *breaking toughness, T, (FL^{-1}), Jm^{-2}, n—for geotextiles,* the actual work-to-break per unit surface area of material.

3.1.1.1 *Discussion*—Breaking toughness is proportional to the area under the force-elongation curve from the origin to the breaking point (see also work-to-break). Breaking toughness is calculated from work-to-break, gage length, and width of a specimen.

3.1.2 *corresponding force, F_c, n*—the force associated with a specific elongation on the force-per-unit-width strain curve. (*Syn.* load at specified elongation, LASE.)

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

4. Summary of Test Method

4.1 A relatively wide specimen is gripped across its entire width in the clamps of a constant rate of extension (CRE) type

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.01 on Mechanical Properties.

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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.

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

tensile testing machine operated at a prescribed rate of extension, applying a longitudinal force to the specimen until the specimen ruptures. Tensile strength, elongation, initial and secant modulus, and breaking toughness of the test specimen can be calculated from machine scales, dials, recording charts, or an interfaced computer.

5. Significance and Use

5.1 The determination of the wide-width force-elongation properties of geotextiles provides design parameters for reinforcement type applications, for example, design of reinforced roadways/pavements, reinforced embankments over soft subgrades, reinforced soil retaining walls, and reinforcement of slopes. When strength is not necessarily a design consideration, an alternative test method may be used for acceptance testing. Test Method D4595/D4595M for the determination of the wide-width tensile properties of geotextiles may be used for the acceptance testing of commercial shipments of geotextiles, but caution is advised since information about between-laboratory precision is incomplete (Note 3). 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 Test Method D4595/D4595M 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. At a minimum, the two parties should take a group of test specimens which are as homogeneous as possible and which 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 began. 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 light of the known bias.

5.2 Most geotextiles can be tested by this test method. Some modification of clamping techniques may be necessary for a given geotextile depending upon its structure. Special clamping adaptions may be necessary with strong geotextiles or geotextiles made from glass fibers to prevent them from slipping in the clamps or being damaged as a result of being gripped in the clamps. Specimen clamping may be modified as required at the discretion of the individual laboratory, provided a representative tensile strength is obtained. In any event, the procedure described in Section 10 of this test method for obtaining wide-width strip tensile strength must be maintained.

5.3 This test method is applicable for testing geotextiles either dry or wet. It is used with a constant-rate-of-extension type tension apparatus.

5.4 The use of tensile strength test methods that restrict the *clamped* width dimension to 50 mm [2 in.] or less, such as the ravel, cut strip, and grab test procedures, have been found less suitable than this test method for determining design strength parameters for some geotextiles. This is particularly the case for nonwoven geotextiles. The wide-width strip technique has been explored by the industry and is recommended in these cases for geotextile applications.

FIG. 1 Hydraulic Clamps

5.4.1 This test method may not be suited for some woven fabrics used in geotextile applications that exhibit strengths approximately 100 kN/m or 600 lbf/in. due to clamping and equipment limitations. In those cases, 100 mm [4 in.] width specimens may be substituted for 200 mm [8 in.] width specimens. On those fabrics, the contraction effect cited in 1.4 is minimal and, consequently, the standard comparison can continue to be made.

6. Apparatus and Reagents

6.1 *Tensile Testing Machine*—A constant rate of extension (CRE) type of testing machine described in Specification D76/D76M shall be used. When using the CRE-type tensile tester, the recorder must have adequate pen response to properly record the force-elongation curve as specified in Specification D76/D76M.

6.2 *Clamps*—The clamps shall be sufficiently wide to grip the entire width of the sample and with appropriate clamping power to prevent slipping or crushing (damage).

6.2.1 There are several types of clamp designs available. Three basic clamp design examples are shown in Fig. 1. These designs have been used in the laboratory and have provided reproducible tensile strengths. These clamps may be modified to provide greater ease and speed of clamping. In any event, caution must be taken to ensure the type material and dimensions of the clamp are adequate for the user's expected fabric strength. Guidance is given in Table 1.

6.2.2 *Size of Jaw Faces*—Each clamp shall have jaw faces measuring wider than the width of the specimen, 200 mm [8 in.], and a minimum of 50 mm [2 in.] length in the direction of the applied force.