INTERNATIONAL

Designation: D6454/D6454M − 99 (Reapproved 2021)

Standard Test Method for Determining the Short-Term Compression Behavior of Turf Reinforcement Mats (TRMs)[1]

This standard is issued under the fixed designation D6454/D6454M; 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 establishes the procedures for evaluation of the deformations of a turf reinforcement mat (TRM) under short-term compressive loading. This test method is strictly an index test method to be used to verify the compressive strength consistency of a given manufactured geosynthetic. Results from this test method should not be considered as an indication of actual or long-term performance of the TRM in field applications.

1.2 Since these TRMs experience multidirectional compressive loadings in the field, this test method will not show actual field performance and should not be used for this specific objective. The evaluation of the results also should recognize that the determination of the short-term single plane compressive behavior of geosynthetics does not reflect the installed performance of TRMs and, therefore, should not be used as the only method of product or performance specification.

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.*

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:*[2]

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

3. Terminology

3.1 *Definitions:*

3.1.1 *compressive deformation, [L], n*—the decrease in gage length produced in the test specimen by a compressive load.

3.1.2 *compressive strain, [nd], n*—the ratio of compressive deformation to the gage length of the test specimen.

3.1.3 *gage length, [L], n*—in compression testing, the measured thickness of the test specimen under specified compressional force, expressed in units of length prior to compressive loading. **D5199**

3.1.4 *geosynthetic, n*—a planar product manufactured from polymeric material used with foundation, soil, rock, earth, or any other geotechnical engineering related material as an integral part of a man-made project, structure, or system. **D4439**

3.1.5 *index test, n*—a test procedure which may contain a known bias but which may be used to establish an order for a set of specimens with respect to the property of interest. **D4439**

3.1.6 *yield point, n*—the first point on the load-deformation curve at which an increase in deformation occurs without a corresponding increase in load.

3.1.6.1 *Discussion*—Some geosynthetics do not exhibit an exact yield point. The tested TRM may exhibit a less steep slope at yield. In addition, it should be stated that the yield point also may be the ultimate strength of the TRM.

3.1.7 For definitions of terms relating to geotextiles, refer to Terminology D4439.

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.05 on Geosynthetic Erosion Control.

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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.

4. Summary of Test Method

4.1 Specimens are mounted between parallel plates in a load frame. Compressive loads are applied at a constant rate of crosshead movement. The deformations are recorded as a function of load. The compressive stress and strain are evaluated and plotted. The compressive yield point is evaluated from the stress/strain relationship for those materials that exhibit a detectable compressive yield point.

5. Significance and Use

5.1 The compression behavior test for TRMs is intended to be an index test. It is anticipated that the results of the compression behavior test will be used to evaluate product. The results of the analyses also may be used to compare the relative compressive yield points of materials that exhibit a detectable compressive yield point. It is anticipated that this test will be used for quality control testing to evaluate uniformity and consistency within a lot or between lots where sample geometry factors, for example, thickness, or materials may have changed.

NOTE 1—This is a one-dimensional test for compressive loading of a TRM in one plane.

5.1.1 The compressive yield point of TRMs may be evaluated from the stress/strain relationship. Many materials exhibit compressive deformation but may not show a distinct compressive yield point.

5.2 This test method can be used to evaluate the short-term stress/strain behavior of TRMs under compressive stress while loaded at a constant rate of deformation.

5.3 This test method may be used for acceptance testing of commercial shipments of TRMs but caution is advised because interlaboratory testing is incomplete.

5.3.1 In the 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 statistical bias between their laboratories. Competent statistical assistance is recommended for the investigations of bias. As a minimum, two parties should take a group of test specimens from material shipped to project. The test specimens then should be assigned randomly in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using the 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 test results in the light of the known bias.

6. Apparatus

6.1 *Loading Mechanism*—The loading mechanism shall be capable of applying compressive loads at a constant rate of deformation of 10 % on the nominal thickness of the test specimen/min or 1 mm/min, whichever is greater.

NOTE 2—Some loading mechanisms, especially the older models, do not have the capability of adjusting the rate of deformation to the specific rate required. For these instruments, the user and producer should establish mutually agreed upon testing rates; however, the rate of deformation selected should not be greater than 10 % on the nominal thickness of the test specimen/min or 1 mm/min, whichever is greater.

6.2 *Fixed Plate*—The bottom fixed plate shall be larger than the specimen to be tested. It shall be flat, smooth, and supported completely and uniformly.

NOTE 3—It is recommended that the minimum fixed plate width be equal to the sample width plus twice the thickness of the test sample. This should support the sample through the range of deformation and prevent draping or flexing displacement.

6.3 *Movable Plate*—The movable plate shall be of sufficient thickness and strength to preclude any bending during loading. It shall be parallel to the bottom fixed plate and attached to the compression mechanism. A spherical loading block of the suspended, self-aligning type is recommended. The dimensions and shape of the top movable plate shall depend on the specimen dimensions and geometry. In general, both length and width of the top movable plate should each be at least 20 % greater than the length and width of the specimens.

6.4 *Load Indicator*—Use a load-indicating mechanism that has an accuracy of ±1 % of the maximum indicated value of the test (force).

6.5 *Deformation Indicator*—Use a deformation-indicating mechanism that has an accuracy of ±1.0 % of the maximum indicated value of the test (deformation).

6.6 *Micrometer Dial Gage,* caliper, or steel rule, suitable for measuring dimensions of the specimens to +1 %.

7. Sampling

7.1 *Lot Sample*—Divide the product into lots and take the lot sample as directed in Practice D4354.

7.2 *Laboratory Sample*—Units in the laboratory sample should be the same as the units in the lot sample for the lot to be tested. Take a sample extending across the full width, that is, cross-machine direction, of the TRM production unit of sufficient length, that is, machine direction, so that the requirements of 7.3 can be met. Take a sample that will exclude material from the outer wrap of a roll, if applicable, unless the sample is taken at the production site, then the inner and outer wrap material may be used.

7.3 *Test Specimens*—Cut five specimens from each unit in the laboratory sample with each specimen being at least 120 by 120 mm/mm^2 [4.7 by 4.7 $in.^2$].

8. Conditioning

8.1 Bring the specimens to the moisture and temperature equilibrium in the atmosphere for testing permanent rolled erosion control products, that is, a temperature of 21 + 2 °C [70 + 4 °F] and a relative humidity of 60 + 10 %.

9. Procedure

9.1 Measure the length, width, and thickness of the specimen to an accuracy of ±1 %.

9.1.1 The nominal thickness shall be determined using Test Method D5199.

9.2 The test specimen shall be placed on the bottom plate and centered with respect to the axis of the loading mechanism.

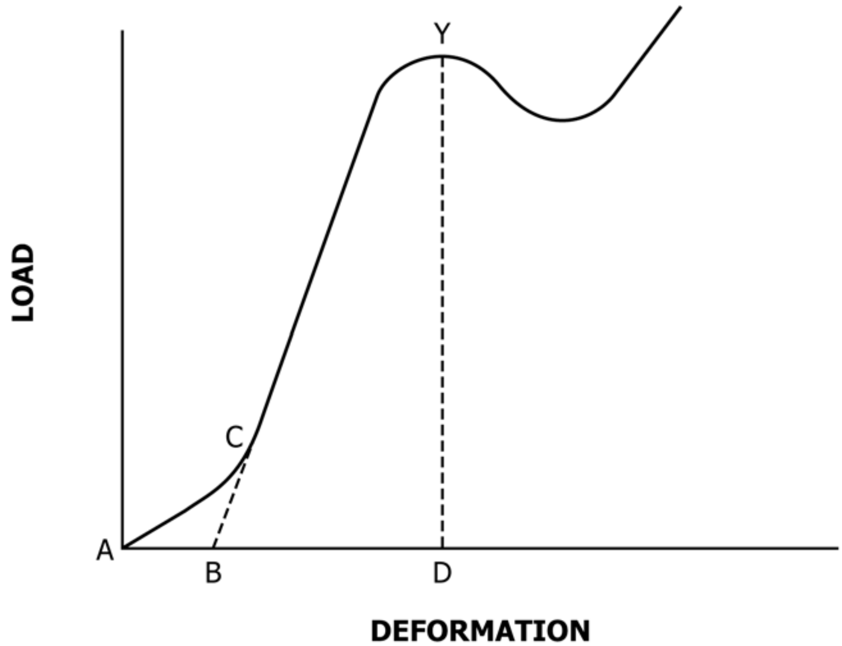

FIG. 1 Typical Load-Deformation Curve

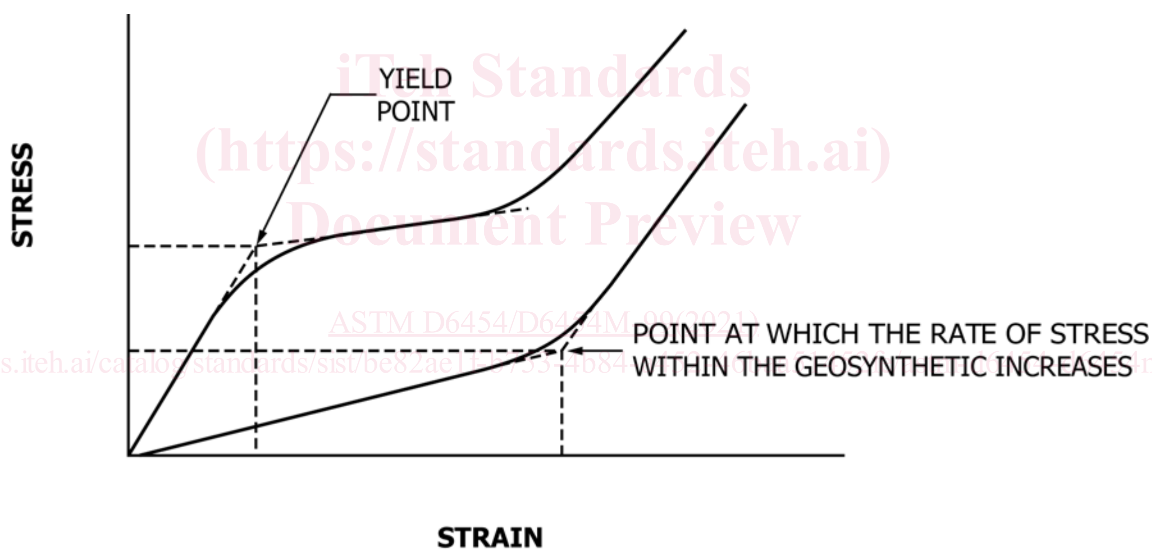

FIG. 2 Stress-Strain Curve

The loading mechanism shall be moving at the required constant speed at or before the point of contact with the sample.

9.3 The rate of crosshead movement shall be 10 % of the nominal thickness of the test specimen/min or 1 ± 0.1 mm [0.04 ± 0.004 in.]/min, whichever is greater or as agreed upon between the user and manufacturer.

9.4 Use crosshead movement as a measure of deformation. If an automatic recorder is not used, measure the deformation in increments no greater than 0.5 % of the original thickness of the specimen. At each measurement, record the deformation and the corresponding load.

9.5 Continue until a yield point is reached, or until the maximum acceptable deformation limit has been reached, whichever occurs first.

9.6 The test specimen then should be unloaded and removed from the loading mechanism.

9.7 Repeat the preceding procedures until five specimens are tested.

10. Calculation

10.1 If an automatic recorder is not used, construct a load-deformation curve from the incremental values obtained in accordance with 9.4.