Designation: D 6575 – 00

Standard Test Method for Determining Stiffness of Geosynthetics Used as Turf Reinforcement Mats (TRM's)[1]

This standard is issued under the fixed designation D 6575; 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 is described for determining the stiffness of geosynthetics used as Turf Reinforcement Mats (TRM).

1.2 The method is applicable to TRMs of any fiber content and any number of components.

1.3 *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:*

D 123 Terminology Relating to Textiles[2]

D 1776 Practice for Conditioning Textiles for Testing[2]

D 4354 Practice for Sampling of Geosynthetics for Testing[3]

D 4439 Terminology for Geotextiles[3]

D 5261 Test Method for Measuring Mass per Unit Area of Geotextiles[3]

2.2 *Federal Standards:*

CCC-T-191b Textile Test Methods No. 5206.2[4]

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *bending length, n*:

3.1.1.1 *general, adj*—a measure of the interaction between geosynthetic weight and geosynthetic stiffness as shown by the way in which a geosynthetic bends under its own weight. It reflects the stiffness of a geosynthetic when bent in one plane under the force of gravity, and is one component of drape.

3.1.1.2 *Discussion*—Bending length is called drape stiffness in Federal Specification CCC-T-191b.

3.1.1.3 *specific, adj*—the cube root of the ratio of the flexural rigidity to the mass per unit area.

3.1.2 *flexural rigidity, n*:

3.1.2.1 *general, adj*—resistance to bending.

3.1.2.2 *Discussion*—Resistance to bending or "flexural rigidity" is called flex stiffness in Federal Specification CCC-T-191b.

3.1.2.3 *specific, adj*—the couple on either end of a sample of unit width bent into unit curvature in the absence of any tension.

3.1.2.4 *Discussion*—The methods measure the bending length. Flexural rigidity is calculated directly by multiplying the cube of the bending length by the weight per unit area (see 3.1.1.3).

3.1.3 *stiffness, n*—resistance to bending.

3.2 *Definitions*—For definitions of other textile or geosynthetic terms used in this test method, refer to Terminologies D 123 and D 4439.

4. Significance and Use

4.1 In general this test method is adapted from tests developed for woven fabrics (previously designated as D 1388).

4.2 The cantilever test method may not be suitable for testing products that are very limp or have a marked tendency to curl or twist at a cut edge.

Cantilever Method

5. Summary of Method

5.1 A specimen of the TRM is slid in a direction parallel to its long dimension, so that its end projects from the edge of a horizontal surface. The length of overhang is measured when the tip of the test specimen is depressed under its own weight to the point where the line joining the tip to the edge of the platform makes an angle of 41.5° with the horizontal. One half of this length is the bending length of the specimen. The cube of this quantity multiplied by the weight per unit area of the geosynthetic is the flexural rigidity.

5.2 This test method is known also as the Single Cantilever Test.

6. Apparatus

6.1 *Stiffness Tester*, having the following parts:

6.1.1 *Horizontal Platform*, with a minimum area of 18 by 12 in. (457.2 by 304.8 mm) and having a smooth low-friction, flat surface such as polished metal or plastic. A leveling bubble shall be incorporated in the platform, or be available for

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[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] *Annual Book of ASTM Standards*, Vol. 07.01.

[3] *Annual Book of ASTM Standards*, Vol 04.09.

[4] Available from the Superintendent of Documents, US Government Printing Office, Washington, DC 20402..

verification that the horizontal platform is level.

6.1.2 *Indicator*, inclined at an angle of 41.5° below the plane of the platform surface.

6.1.3 *Weight*, consisting of a metal bar not less than 4 by 18 in. (101.6 by 457.2 mm) by about ⅛ in. (3 mm) thick.

6.1.4 *Scale and Pointer*, to measure the length of the overhang.

7. Conditioning

7.1 For tests made as directed in 9.1-9.5, bring the specimens to a moisture equilibrium in the atmosphere for testing TRMs, that is a temperature of 21 ± 2°C (70 ± 4°F) and relative humidity of 60 ± 10 %.

8. Selection and Preparation of Specimens

8.1 Cut test specimens 4 by 18 in. (101.6 by 457.2 mm). Cut four specimens with the long direction parallel to the machine direction and four with the long direction parallel to the transverse (or cross-machine) direction. If the geosynthetic is not uniform or a higher degree of precision is required, more may be tested. Vary cutting the specimens in such a way that the machine direction specimens do not contain the same machine direction yarns/filaments for the machine direction tests and cut the cross-machine direction specimens so that separate cross-machine direction yarns/filaments are contained in each. Avoid selvages, end pieces, and creased or folded places, and handle the specimens as little as possible.

NOTE 1—Some TRMs are constructed from several component materials and sample preparation must be performed in such a way as to maintain the structural integrity of the product. Procedures found to be successful for cutting test specimens from TRMs include the use of hot knives to seal the edges and the use of bags and slip covers to keep all components together during sample preparation. The method of cutting the specimen should be included in the report.

9. Procedure

9.1 Make tests on conditioned specimens in the standard atmosphere for testing.

9.2 Set the tester on a table or bench so that the horizontal platform and inclined reference lines are at eye level. Adjust the platform so that it is horizontal as indicated by the leveling bubble.

9.3 Place a specimen on the platform with the weight on top of it so that the leading edges coincide. Holding weight in a horizontal plane, slide the specimen and weight slowly and steadily until the leading edges project beyond the edge of the platform. With the eye in a position so that the two inclined lines of the tendency to twist, take the reference point at the center of the leading edge. Do not measure specimens that twist more than 45°. Read the length of overhang from the scale to the nearest 1 mm.

9.4 Take four readings from each specimen, with each side up, first at one end and then the other.

9.5 Determine the mass per unit area of the geosynthetic according to [see Text Method D 5261].

10. Calculation

10.1 Unless otherwise specified, average the four readings obtained from all the specimens cut parallel to the machine direction. Do the same for those cut parallel to the cross-machine direction. In some cases it may be of interest to differentiate between the sides of the geosynthetic by averaging those readings made with the face side up separately from those with the reverse side up. If this is done, specify the direction of bending. Call these averages the "length of overhang," and express them in Cm. Calculate the bending length, *c*, in centimeters, and the flexural rigidity, *G*, in mg/cm by Eq 1 and 2:

$$\text{Bending length, } c = 0/2 \tag{1}$$

where L_o = the length of overhang, cm.

$$\text{Flexural rigidity, } G = W \times (0/2)^3 = W \times c^3 \tag{2}$$

where W = weight per unit area, mg/cm^2.

NOTE 2—To obtain the weight in mg/cm^2, multiply ozlyd^2 by 3.39. Federal Specification CCC-T-191b gives flexural rigidity in in.-lb. To convert in.-lb to mg-cm, multiply by 1.15 × 10^6.

11. Report

11.1 Report to three significant figures the flexural rigidity of the machine direction and cross-machine direction separately. If an over-all average figure for the geosynthetic is required, calculate the geometric mean of these two values by Eq 3:

$$G = (G_{MD} G_{CD})^{1/2} \tag{3}$$

where:

G_o = over-all flexural rigidity,
G_{MD} = machine direction flexural rigidity, and
G_{CD} = cross-machine flexural rigidity.

12. Precision and Bias

12.1 Lack of well-defined units of stiffness makes it impossible to give a reliable estimate of the bias of this test method. It has been shown to give excellent correlation with a purely subjective evaluation obtained by feeling samples for several ranges of geosynthetics of widely differing stiffness; however, it is to be expected that inversions may exist in such a comparison. It has been found that differences in flexural rigidity of about 10 % can just be detected subjectively, and that this is about the limit of reliability of stiffness test results. It also has been found that results obtained by different operators in different laboratories are as reproducible as those obtained by different operators within one laboratory. The inherent stiffness of a geosynthetic may change depending temperature (or moisture-content if a biodegradable component is present.)