



Designation: D6566 – 18 (Reapproved 2023)

# Standard Test Method for Measuring Mass Per Unit Area of Turf Reinforcement Mats<sup>1</sup>

This standard is issued under the fixed designation D6566; 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 covers an index to the determination of mass per unit area of all turf reinforcement mats.

1.2 The values stated in SI units are to be regarded as standard. The values given in parentheses are for information only.

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

1.4 *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>

D123 Terminology Relating to Textiles

D1776 Practice for Conditioning and Testing Textiles

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

D4439 Terminology for Geosynthetics

E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

E691 Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method

2.2 *ISO/DIS Document:*<sup>3</sup>

9864-1990 Mass Per Unit Area of Geotextiles

<sup>1</sup> 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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<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.

<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, <http://www.ansi.org>.

## 3. Terminology

3.1 For definitions of textile terms used in this test method, refer to Terminology D123.

3.2 For definitions of terms relating to geotextiles used in this test method, refer to Terminology D4439.

## 4. Summary of Test Method

4.1 The mass per unit area of a turf reinforcement mat is determined by weighing test specimens of known dimensions, cut from equally spaced distances over the full width of the laboratory sample. The calculated values are then averaged to obtain the mean mass per unit area of the laboratory sample.

## 5. Significance and Use

5.1 This test method is used to determine if the turf reinforcement mat meets specifications for mass per unit area. This test method can be used for quality control to determine specimen conformance. This measurement allows for a simple control of the delivered material by a comparison of the mass per unit area of the delivered material and the specified mass per unit area.

5.2 The procedure in this test method may be used for acceptance testing of commercial shipments, but caution is advised since information about between-laboratory precision is incomplete. Comparative tests in accordance with 5.2.1 are advisable.

5.2.1 In case of a dispute arising from differences in reported test results when using the procedures in this test method for acceptance testing of commercial shipments, the purchaser and the manufacturer 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 that are as homogeneous as possible and which are from a lot of material of the type in question. The test specimen should then be randomly assigned in equal numbers to each laboratory for testing. The average results from the two laboratories should be compared using the appropriate Student's *t*-test and an acceptable probability level chosen by the two parties before testing is begun. If a bias is found, either its cause must be found and corrected or the purchaser and the manufacturer must agree to interpret future test results in light of the known bias.

**6. Apparatus**

6.1 *Balance*, calibrated, with an accuracy of 0.01 g.

**7. Sampling**

7.1 *Lot Sample*—In the absence of other guidelines, divide the product into lots and take lot samples in accordance with Practice D4354.

7.2 *Laboratory Sample*—For the laboratory sample, take a full-width sample of sufficient length in the machine direction so that the required size and number of specimens can be obtained. Exclude the inner and outer layers or 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 so that each specimen will contain different machine and cross-machine elements with no specimen taken nearer than 100 mm (4 in.) from the roll sides or ends, unless otherwise specified.

7.4 Cut specimens such that they are representative of the entire roll width and with a combined total minimum area of 230 000 mm<sup>2</sup> (356 in.<sup>2</sup>). Each test specimen shall be equal in area (not less than 23 000 mm<sup>2</sup> (35.6 in.<sup>2</sup>)). Cut each test specimen with an accuracy of ±0.5 % of its area.

NOTE 1—For test specimens prepared in the field, larger than minimum-sized test specimens will be required to stay within the cutting accuracy (0.5 %). Field experience has shown that a test specimen with an area not less than 207 000 mm<sup>2</sup> (320.4 in.<sup>2</sup>) will be necessary to achieve the required accuracy.

7.4.1 Cut the test specimens at least one-tenth the width of the turf reinforcement mat from any selvage, unless otherwise specified.

7.4.2 If the structure of the turf reinforcement mat is such that the specified test specimen size is not representative of the laboratory sample, a larger size shall be agreed upon between the purchaser and the supplier.

7.5 *Number of Specimens*—Unless otherwise agreed upon, as when provided in an applicable material specification, take the number of test specimens per laboratory 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 this test method, calculate the required number of specimens as follows so that the user may expect at the 95 % probability level that the test result is not more than 5.0 % of the average above or below the average of the sample:

$$n = (t v / A)^2 \tag{1}$$

where:

- n* = number of test specimens (rounded upward to a whole number),
- v* = coefficient of variation of individual observations on similar materials in the user’s laboratory under conditions of single-operator precision, %,
- t* = value of Student’s *t* for one-sided limits, a 95 % probability level, and the degrees of freedom associated with the estimate of *v* (see Table 1), and
- A* = 5.0 % of the average, the value of the allowable variation.

7.5.2 *No Reliable Estimate of v*—When there is no reliable estimate of *v* for the user’s laboratory, measurements shall be made on a minimum of five (5) specimens per laboratory sample.

**8. Conditioning**

8.1 Bring the specimens to moisture equilibrium in the atmosphere for testing turf reinforcement mats, that is, a temperature of 21 °C ± 2 °C (70 °F ± 4 °F) and relative humidity of 60 % ± 10 %.

8.2 Moisture equilibrium is considered to have been reached when the increase in mass of the specimen in successive measurements made at intervals of not less than 2 h does not exceed ±0.1 % of the mass of the specimen. In general, many turf reinforcement mats contain more moisture when received than they will after reaching moisture equilibrium. However, certain fibers may exhibit slow moisture equilibrium rates from the “as-received” wet side. When this is known, a preconditioning cycle, as described in Practice D1776, may be agreed upon between contractual parties.

**9. Procedure**

9.1 Test the conditioned test specimens in the standard atmosphere for testing turf reinforcement mats as prescribed in 8.1.

9.2 Care should be taken in handling of the test specimens to avoid altering the natural finished state of the material.

9.3 Weigh each of the conditioned specimens separately on a calibrated balance to the nearest 0.01 g.

**10. Calculation**

10.1 Calculate the mass per unit area of each of the specimens as follows:

$$m = M_s \times 1\,000\,000 / A \tag{2}$$

where:

- m* = mass per unit area rounded to the nearest 0.1 g/m<sup>2</sup>,
- M<sub>s</sub>* = mass of the specimen, g, and
- A* = area of the specimen, mm<sup>2</sup>.

10.2 Repeat this procedure for each test specimen.

10.3 Calculate the average and standard deviation of the mass per unit area results for the test specimens.

**TABLE 1 Values of Student’s *t* for One-Sided Limits and the 95 % Probability**

df	One-Sided	df	One-Sided	df	One-Sided
1	6.314	11	1.796	22	1.717
2	2.920	12	1.782	24	1.711
3	2.353	13	1.771	26	1.706
4	2.132	14	1.761	28	1.701
5	2.015	15	1.753	30	1.697
6	1.943	16	1.746	40	1.684
7	1.895	17	1.740	50	1.676
8	1.860	18	1.734	60	1.671
9	1.833	19	1.729	120	1.658
10	1.812	20	1.725	∞	1.645

**TABLE 2 Mass Per Unit Area (gm/m<sup>2</sup>)**

Material	Average <sup>A</sup>	Repeatability Standard Deviation	Reproducibility Standard Deviation	Repeatability Limit	Reproducibility Limit
	$\bar{x}$	$S_r$	$S_R$	$r$	$R$
Double Net Poly Fiber-Filled Matting	319.63 <sup>B</sup>	95.78	99.26	268.18	277.93
Double Net Poly Fiber-Filled Matting	388.71 <sup>B</sup>	54.97	54.97	153.91	153.91
Woven TRM	269.43 <sup>C</sup>	3.47	7.05	9.73	19.74

<sup>A</sup> The average of the laboratories' calculated averages.

<sup>B</sup> Usable data included from seven laboratories.

<sup>C</sup> Usable data included from five laboratories.

## 11. Report

11.1 Report the following information on mass per unit area of turf reinforcement mats:

11.1.1 Type of turf reinforcement mat tested, sampling method used, the test specimen size, shape, and the number of test specimens tested,

11.1.2 The average mass per unit area and standard deviation to three significant figures, and

11.1.3 A statement of any departures from the suggested testing procedures so that the results can be evaluated and used.

## 12. Precision and Bias

12.1 *Precision*—The precision of this test method is based on two interlaboratory studies of Test Method D6566, conducted in 2013 and 2014. Eight laboratories participated in the 2013 study and six laboratories participated in the 2014 study. Each of the labs reported three replicate test results for each of the tested RECPs. Every “test result” reported represents the average of five test specimens as required by the standard. Practice E691 was followed for the design and analysis of the data; the details are given in ASTM Research Report Nos. RR:D35-1017<sup>4</sup> and RR:D35-1024.<sup>5</sup>

12.1.1 *Repeatability* ( $r$ )—The difference between repetitive results obtained by the same operator in a given laboratory applying the same test method with the same apparatus under constant operating conditions on identical test material within short intervals of time would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in 20.

12.1.1.1 Repeatability can be interpreted as the maximum difference between two results, obtained under repeatability

<sup>4</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D35-1017. Contact ASTM Customer Service at service@astm.org.

<sup>5</sup> Supporting data have been filed at ASTM International Headquarters and may be obtained by requesting Research Report RR:D35-1024. Contact ASTM Customer Service at service@astm.org.

conditions, that is accepted as plausible due to random causes under normal and correct operation of the test method.

12.1.1.2 Repeatability limits are listed in Table 2.

12.1.2 *Reproducibility* ( $R$ )—The difference between two single and independent results obtained by different operators applying the same test method in different laboratories using different apparatus on identical test material would, in the long run, in the normal and correct operation of the test method, exceed the following values only in one case in 20.

12.1.2.1 Reproducibility can be interpreted as the maximum difference between two results, obtained under reproducibility conditions, that is accepted as plausible due to random causes under normal and correct operation of the test method.

12.1.2.2 Reproducibility limits are listed in Table 2.

12.1.3 The above terms (repeatability limit and reproducibility limit) are used as specified in Practice E177.

12.1.4 Any judgment in accordance with statements 12.1.1 and 12.1.2 will have an approximate 95 % probability of being correct. The precision statistics obtained in this ILS must not be treated as exact mathematical quantities which are applicable to all circumstances and uses. The limited number of materials tested may lead to times when differences greater than predicted by the ILS results will arise, sometimes with considerably greater or smaller frequency than the 95 % probability limit would imply.

12.2 *Bias*—At the time of the study, there was no accepted reference material suitable for determining the bias for this test method, therefore no statement on bias is being made.

12.3 The precision statement was determined through statistical examination of all usable test results, from seven laboratories, on three materials.

12.4 To judge the equivalency of two test results, it is recommended to choose the mat material closest in characteristics to the test material.

## 13. Keywords

13.1 mass per unit area; turf reinforcement mats; weight