



Designation: ~~D7101~~—~~08~~ D7101 – 13

Standard Index Test Method for Determination of Unvegetated Rolled Erosion Control Product (RECP) Ability to Protect Soil from Rain Splash and Associated Runoff Under Bench-Scale Conditions¹

This standard is issued under the fixed designation D7101; 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 reappraisal. A superscript epsilon (ϵ) indicates an editorial change since the last revision or reappraisal.

1. Scope*

1.1 This index test method establishes the guidelines, requirements and procedures for evaluating the ability of unvegetated rolled erosion control products (RECPs) to protect soils from simulated rainfall (rain splash) and minimal runoff induced erosion. The critical element of this protection is the ability of the unvegetated RECP to absorb the impact force of raindrops, thereby reducing soil particle loosening through “splash” mechanisms, and limiting the ability of runoff to carry the loosened soil particles.

1.2 This index test method utilizes bench-scale testing procedures and is not indicative of unvegetated RECP performance in conditions typically found in the field.

NOTE 1—The values obtained with this bench scale procedure are for initial performance indication, general product comparison and conformance purposes only. These values should not be used in estimating RECP soil protection in actual field use with such calculations as the Universal Soil Loss Equation (USLE) or Revised Universal Soil Loss Equation (RUSLE) without verification from qualified, large-scale tests.

1.3 This index test is not intended to replace full-scale simulation or field testing in acquisition of performance values that are required in the design of erosion control measures utilizing unvegetated RECPs.

1.4 The values stated in SI units are to be regarded as the standard. The values given in parentheses are ~~for information only.~~ mathematical conversions to inch-pound units that are provided for information only and are not considered standard.

1.5 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice ~~D6026~~, unless superseded by this standard.

1.5.1 The procedures used to specify how data are collected/recorded or calculated in this standard are regarded as the industry standard. In addition, they are representative of the significant digits that generally should be retained. The procedures used do not consider material variation, purpose for obtaining the data, special purpose studies, or any considerations for the user’s objectives, and it is common practice to increase or reduce significant digits of reported data to be commensurate with these considerations. It is beyond the scope of this index test method to consider significant digits used in analytical methods for engineering design.

1.6 *This standard does not purport to address all of the safety concerns, if any, associated with its use and may involve use of hazardous materials, equipment, and operations. 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. Also, the user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines, while using the index test method.*

2. Referenced Documents

2.1 ASTM Standards:²

[D653 Terminology Relating to Soil, Rock, and Contained Fluids](#)

[D698 Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort \(12 400 ft-lbf/ft³ \(600 kN-m/m³\)\)](#)

[D6026 Practice for Using Significant Digits in Geotechnical Data](#)

[D3740 Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction](#)

¹ This test method is under the jurisdiction of ASTM Committee D18 on Soil and Rock and is the direct responsibility of Subcommittee D18.25 on Erosion and Sediment Control Technology.

Current edition approved ~~Jan. 1, 2008~~ June 15, 2013, Published ~~February 2008~~ July 2013. Originally approved in 2007. Last previous edition approved in ~~2007~~ 2008 as ~~D7101—07~~ D7101 – 08. DOI: ~~10.1520/D7101-08~~ 10.1520/D7101-13.

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.

*A Summary of Changes section appears at the end of this standard

D6459 Test Method for Determination of Rolled Erosion Control Product (RECP) Performance in Protecting Hillslopes from Rainfall-Induced Erosion

D6475 Test Method for Measuring Mass Per Unit Area of Erosion Control Blankets

D6566 Test Method for Measuring Mass per Unit Area of Turf Reinforcement Mats

3. Terminology

3.1 *Definitions*—For common definitions of terms in this standard, refer to Terminology **D653**.

4. Summary of Test Method

4.1 Soil cores consisting of containers with both bare and unvegetated RECP-protected soil are exposed to simulated rainfall.

4.2 The amount of soil that splashes out of or is dislodged and carried by runoff from the containers is collected and weighed. The results can be used to compare bare and RECP-protected situations.

4.3 Key elements of the testing process include: ~~1)(1)~~ calibration of the rainfall simulation equipment; ~~2)(2)~~ preparation of the test cores; ~~3)(3)~~ documentation of the RECP to be tested; ~~4)(4)~~ installation of the RECP; ~~5)(5)~~ prosecution of the test; ~~6)(6)~~ collection of data; ~~7)(7)~~ analysis of the resultant data, and; ~~8)(8)~~ data; and ~~(8)~~ reporting.

5. Significance and Use

5.1 This index test method indicates a unvegetated RECP's ability to reduce rainsplash-induced erosion under bench-scale conditions. This test method may also assist in identifying physical attributes of RECPs that contribute to their erosion-control performance.

5.2 This test method is bench-scale and therefore, appropriate as an index test for initial indication of product performance, for general comparison of unvegetated RECP capabilities, and for product quality assurance/conformance testing. The results of this test are not indicative of an RECP's actual field performance.

NOTE 2—The quality of the result produced by this standard is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice **D3740** are generally considered capable of competent and objective testing/sampling/inspections/etc. Users of this standard are cautioned that compliance with Practice **D3740** does not itself assure reliable results. Reliable results depend on many factors; Practice **D3740** provides a means of evaluating some of those factors.

6. Apparatus

6.1 *Rainfall Simulator*—Rainfall is produced by a laboratory simulator capable of creating uniform drops with a median diameter of 3.0 to 3.5 mm (0.12 to 0.14 in.) from a drop height of 2000.0 mm (78.72 in.) above the lowest point of the incline structure (see **6.3**). The rainfall simulator shall be capable of producing rainfall intensities of 51 ± 5 mm/hr (2 ± 0.2 in./hr), 102 ± 5 mm/hr (4 ± 0.2 in./hr), and 153 ± 5 mm/hr (6 ± 0.2 in./hr). The simulator must be centered over the test area to provide uniform rain application over the entire incline structure (**Fig. 1**).

6.2 *Soil Cores*—Consist of water-tight containers nominally 200 ± 10 mm (8 ± 0.4 in.) inside diameter plastic pipe section cylinders with height of 100 ± 10 mm (4 ± 0.4 in.) holding soil and test specimens.

6.3 *Incline Structure*—Required is an incline structure comprised of three adjacent “runoff ramps” each having an opening at its lower end to accommodate a recessed soil core. The ramps shall be 900 ± 20 mm (35 ± 0.8 in.) in length and 250 ± 20 mm wide (10 ± 0.8 in.). The incline structure shall be adjustable to a slope gradient of at least 3:1 (horizontal:vertical) and be able to maintain the desired slope. The incline structure shall have raised dividers (at least 25.0 mm (1 in.) tall) between ramps to prevent cross-ramp soil splash and run-on/runoff (**Fig. 1**).

6.4 *Collection Buckets*—Any type of bucket having sufficient diameter and volume to collect all runoff from the runoff ramp may be used.

6.5 *Filters*—Whatman #3 filter paper³ to separate sediment from soil and water solution.

6.6 *Miscellaneous*—Other miscellaneous equipment includes: sieve set (standard US sieves), evaporating dishes, drying oven, and balance.

7. Sampling

7.1 The laboratory sample should be 1 m² (10.76 ft²).

8. Procedure

8.1 *Calibration of Rainfall Simulator*~~Simulator~~:

³ The sole source of supply of the apparatus known to the committee at this time is Whatman Inc., 200 Park Ave., Suite 210, Florham Park, New Jersey, 07932, www.whatman.com. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee,¹ which you may attend.

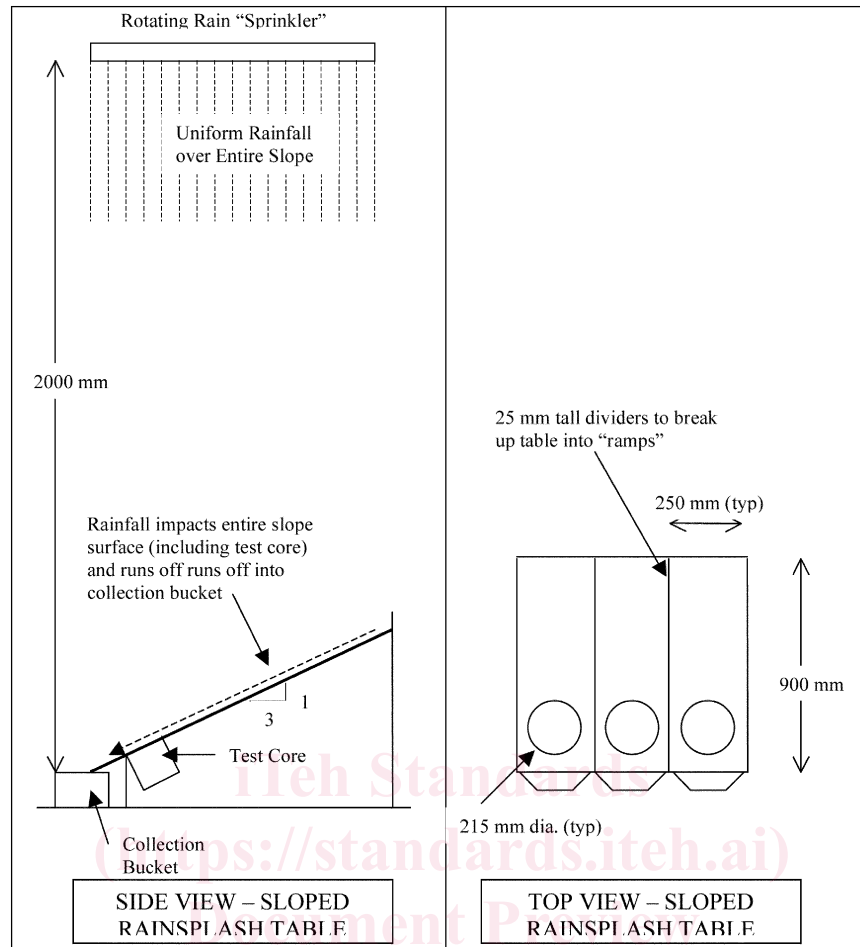


FIG. 1 Slope Erosion: Bench Scale Laboratory Test Apparatus

8.1.1 Calibration of the rainfall simulation equipment includes verification of: 1) rainfall intensity; 2) uniformity of rainfall application across the holding container; and 3) drop size. See Annex A1 for details.

8.1.2 At a minimum, calibration shall be conducted on an annual basis and also following initial equipment set-up and any equipment maintenance.

8.2 Test Set-up

8.2.1 After calibration, prepare three soil cores for each RECP to be tested and nine cores for the bare soil conditions.

8.2.1.1 Fill/compact (see 8.2.1.2) the cores with the standard soil (see Annex A2 for soil details) flush with the lip of the container.

NOTE 3—The standard sand used referenced in this test procedure has been found to be successful historically used for product comparison purposes. However, site-specific soils, user-defined soils, or both, may be used based on user needs. If non-standard soils are used, agreement should be established between the testing laboratory and the test user. The effect of utilizing a non-standard soil is unknown.

8.2.1.2 Unless otherwise agreed to prior to testing, compact the soil into the soil cores at $90 \pm 3\%$ of standard dry density at optimum moisture content $\pm 2\%$.

8.2.2 Adjust the incline structure to a gradient of 3:1 (h:v), unless other slope gradient(s) are agreed to between the test laboratory and the user of the test.

NOTE 4—An incline of 3:1 (h:v) has been historically used for product comparison purposes. An alternate gradient may be utilized, however, the gradient should be agreed upon between the test laboratory and the user of the test. The effect of utilizing a non-standard gradient is unknown.

8.2.3 Place three of the prepared soil cores into the openings of the incline structure. The top edges of the cores are to be a minimum of 2 cm (0.8 in.) away from the sides of the runoff ramps.

8.2.4 For RECP-protected cores, place the RECP test sample over the entire incline structure including the soil core surfaces. Clip or otherwise affix the sample to the raised barriers between runoff ramps in such a way to avoid obstruction of flow and facilitate intimate contact with the runoff ramp and the soil surfaces of the cores.

8.2.4.1 Each RECP specimen shall be weighed and measured to determine its mass per unit area in accordance with Test Methods D6475 and D6566 prior to affixing to the runoff ramps.

8.3 *Test Operation and Data Collection*

8.3.1 Cover the incline structure and soil cores with a waterproof lid or canopy and activate rainfall simulator at the target intensity. Both the RECP protected and bare soil control cores shall be subjected to three target rainfall intensities of 51 ± 5 mm/hr (2 ± 0.2 in./hr), 102 ± 5 mm/hr (4 ± 0.2 in./hr), and 153 ± 5 mm/hr (6 ± 0.2 in./hr), unless other intensities are agreed upon between the user of the test and testing laboratory.

8.3.2 After rainfall reaches a steady rate, position the collection buckets at the end of the runoff ramps and remove the cover from the incline structure and begin timing the test.

8.3.3 After five minutes, replace the waterproof cover or turn off the rainfall and take the collection buckets out of the simulator.

8.3.4 Position empty collection buckets at the end of the runoff ramps, remove the cover or turn rainfall back on, and resume the test.

8.3.5 Repeat 8.3.3 and 8.3.4 every 5 min.

8.3.6 Pour the water and soil mixture from the collection buckets through a Whatman #3 filter paper to collect the sediment from the first five minutes of the test. Measure and record the amount of water collected in each bucket. Additional water may be used in order to wash all the soil out of the holding container.

8.3.7 Repeat this process until the set of three soil cores has undergone six five-minute periods of simulated rainfall, which equals 30 min of exposure to simulated rain.

8.3.8 Dry each sediment sample in an oven at 105°C (221°F) for a minimum of 24 h, then weigh sample and determine mass to ± 0.01 g. The data for each pot should be entered into a table such as shown in Fig. 2.

8.3.9 Repeat the procedure with the remaining sets of three test cores at each target rainfall intensity.

9. Calculation

9.1 Average the three masses of sediment corresponding to the same five-minute period(s) to obtain six mean masses of soil loss from the RECP-protected cores at each target rainfall intensity.

9.1.1 The data for each pot should be entered into a table such as shown in Fig. 2 and normalized to the sample roll average mass per unit area based on the specimen-specific mass per unit area for the pot.

9.2 Sum the six mean masses of soil loss from the RECP-protected soil cores to obtain the mean mass (M_{RECP}) for the entire 30 min run at each rainfall intensity.

9.3 Average the three masses of sediment corresponding to the same five-minute period(s) to obtain six mean masses of soil loss from the bare soil cores at each target rainfall intensity.

9.4 Sum the six mean masses of soil loss from the bare soil control cores to obtain the mean mass (M_{control}) for the entire 30 min run at each target rainfall intensity.

9.5 Enter the mean masses obtained for the RECP and bare soil control cores as a function of time at each target rainfall intensity into a table.

9.6 Calculate the Bench-Scale Cover Index (BSCI) of the test material at each rainfall intensity as follows:

$$BSCI = M_{\text{RECP}}/M_{\text{CONTROL}} \quad (1)$$

where:

M_{RECP} = mean mass of soil loss from RECP protected cores according to 9.2, and

M_{CONTROL} = mean mass of soil loss from unprotected control cores according to 9.4.

9.7 All observed and calculated values shall conform to the guidelines for significant digits and rounding established in Practice D6026, unless superseded by this standard.

10. Report

10.1 The report shall at a minimum include the following:

10.1.1 General information, including test facility location, date, time and operator name.

10.1.2 Calibration data and analysis (latest information).

10.1.3 Test set-up activities, including 1) test conditions (slope gradient, rainfall intensity); 2) soil type and conditions; 3) RECP product type and description; and 4) soil loss (g).

10.1.3.1 The sand gradation and standard proctor moisture-density relationship shall be reported. If other soils are used, the soils' information shall include: soil type/texture (that is, topsoil, sandy loam, silt loam, clay); standard proctor moisture-density relationship; gradation (including hydrometer test for the P200 fraction); organic matter content; plasticity indices; and pH.

10.1.4 Raw data and mean soil masses.

10.1.5 A table, graph, or both, of the mean soil loss masses as a function of time at each rainfall intensity.

10.1.6 The calculated BSCI for the test material at each rainfall intensity.