ECTC Test Protocol
(10 January 2003)
Approval 5 December 2003

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

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Designation: ECTC Test Method 2

STANDARD INDEX TEST METHOD FOR the DETERMINATION of UNVEGETATED ROLLED EROSION CONTROL PRODUCT (RECP) ABILITY TO PROTECT SOIL FROM RAIN SPLASH AND ASSOCIATED RUNOFF UNDER BENCH-SCALE CONDITIONS

1.0 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: 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 standard. The inch-pound values given in parentheses are provided for information purposes only.

1.5 This index test method does not purport to address all the safety problems, if any, associated with its use and may involve use of hazardous materials, equipment, and operations. It is the responsibility of the user to establish and adopt appropriate safety and health practices. Also, the user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines, while using the test method.

2.0 Referenced Documents

2.1 ASTM Standards
D 698 Test method for Laboratory Compaction Characteristics of Soil using Standard Effort
D 6459 Test method for Determination of Erosion Control Blanket Performance in Protecting Hill Slopes from Rainfall-Induced Erosion

3.0 Terminology

3.1 Rolled Erosion Control Product (RECP), n - A temporary degradable or long-term non-degradable material manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation.

3.2 Temporary degradable, n – An RECP composed of biologically, photochemically or otherwise degradable materials that temporarily reduces soil erosion and enhances the establishment of vegetation.

3.3 Long-term non-degradable, n – An RECP composed of non-degradable materials that furnishes erosion protection and extends the erosion control limits of vegetation for the design life of a project.

3.4 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.

3.5 Lot, n - a unit of production, or a group of other units or packages, taken for sampling or statistical examination, having one or more common properties and being readily separable from other similar units.

3.6 Sample, n - a portion of material which is taken for testing or recording purposes and used in the laboratory as a source of individual specimens.

4.0 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) calibration of the rainfall simulation equipment; 2) preparation of the test cores; 3) documentation of the RECP to be tested; 4) installation of the RECP; 5) prosecution of the test; 6) collection of data; 7) analysis of the resultant data, and; 8) reporting

5.0 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.

6.0 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 $\pm$ 5 mm/hr (2 $\pm$ 0.2 in/hr), 102 + 5 mm/hr (4 $\pm$ 0.2 in/hr), and 153 $\pm$ 5 mm/hr (6 $\pm$ 0.2 in/hr.). The simulator must be centered over the test area to provide uniform rain application over the entire incline structure. (See Figure 1.)

6.2 Soil Cores – Consist of water-tight containers nominally 200 $\pm$ 10 mm (8 $\pm$ 0.4 in) inside diameter plastic pipe section cylinders with height of 100 $\pm$ 10 mm (4 $\pm$ 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. (See Figure 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.

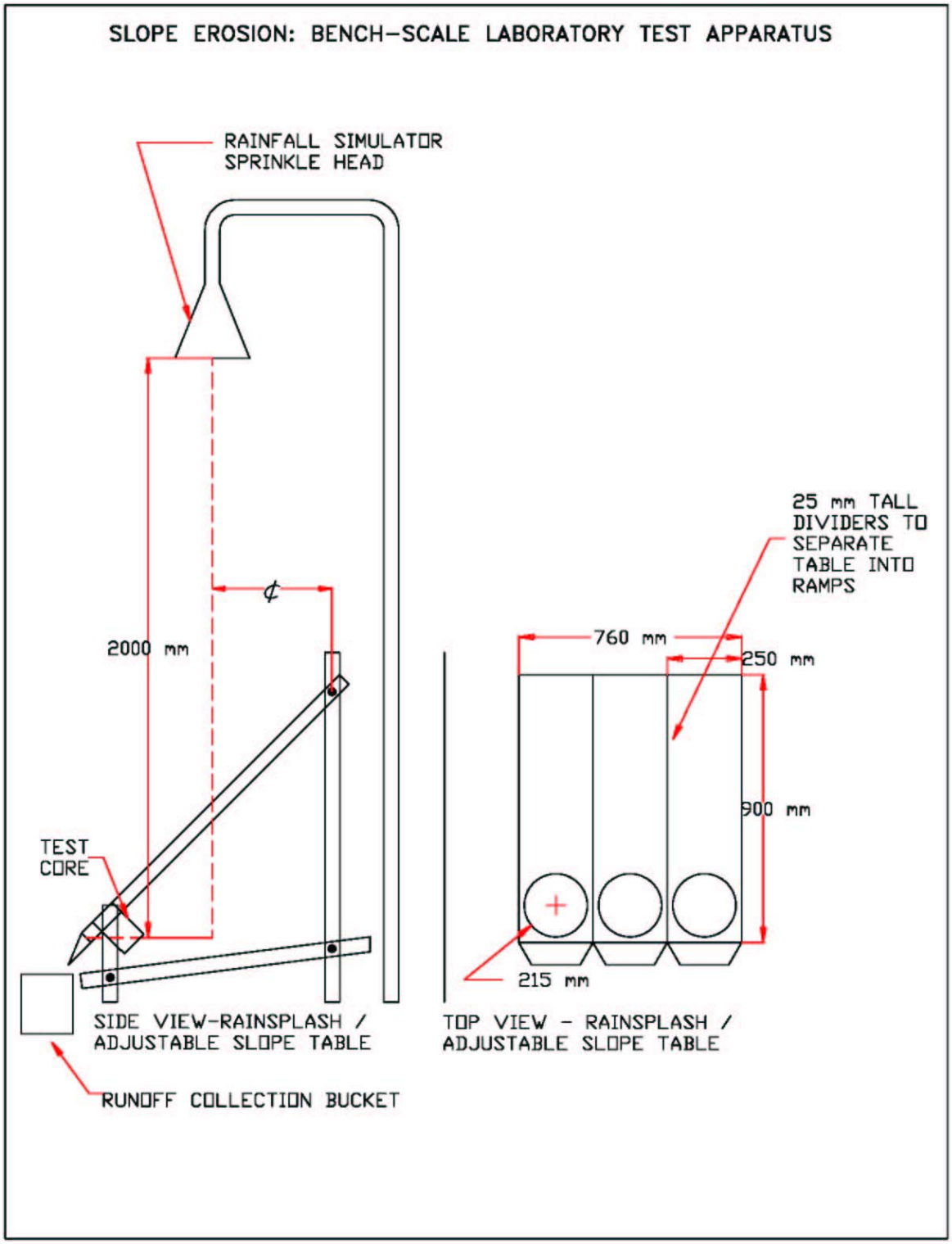
6.5 Filters- Whatman #3 filter paper to separate sediment from soil and water solution

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

7.0 Sampling

7.1 The laboratory sample should be 1 m^2 (10.76 ft^2).

FIG. 1. SLOPE EROSION: BENCH SCALE LABORATORY TEST APPARATUS



8.0 Procedure

8.1 Calibration of Rainfall Simulator

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 1.0 for details.

8.1.2 At a minimum, calibration shall be conducted on an annual basis and also following initital 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 A2.0 for soil details) flush with the lip of the container.

NOTE: The standard sand used in this test procedure has been found to be successful for product comparison purposes. However, site-specific and/or user-defined soils may be used based on user needs. If non-standard soils are used, agreement should be established between the testing laboratory and the user of the test

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

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 soil surfaces of the cores.

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 $\pm$ 5 mm/hr (2 $\pm$ 0.2 in/hr), 102 $\pm$ 5 mm/hr (4 $\pm$ 0.2 in/hr), and 153 $\pm$ 5 mm/hr (6 $\pm$ 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 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, and resume the test.

8.3.5 Repeat 8.3.3 and 8.3.4 every 5 minutes.

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. 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 minutes 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 hours, then weigh sample and determine mass to ± 0.01 g.

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

9.0 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.

9.2 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 minute 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 minute run at each target rainfall intensity.

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

9.6 Calculate the Soil Loss Ratio (SLR) of the test material at each rainfall intensity as follows:

$$SLR = M_{control} / M_{RECP}$$

10.0 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, and; 3) RECP product type and description, 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 (i.e. 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 and/or graph of the mean soil loss masses as a function of time at each rainfall intensity

10.1.6 The calculated Soil Loss Ratio (SLR) for the test material at each rainfall intensity.

11.0 Precision and Bias

11.1 Precision - The precision of this test method is being established.

11.2 Bias - The true value of erosion control performance of unvegetated RECPs can be defined only in terms of a test method. Within this limitation, the procedure described herein has no known bias and, since there is not an accepted referee test method, the procedures of this test method have no inherent bias.

12.0 Keywords

12.1 Erosion control, rolled erosion control product, RECP, rainfall simulation, sediment and slope.

ANNEX

(Mandatory Information)

A1.0 Calibration of Rainfall Simulator

A1.1 Calibration of Rainfall Intensity and Uniformity of Rainfall Distribution

A1.1.1 Place at least four rain gauges in a holding container and cover with a waterproof lid or canopy.

A1.1.2 Turn on the rain simulator and allow it to reach a steady rate of rainfall.

A1.1.3 Allow the calibration test to proceed for at least 15 minutes. Operating conditions representing those to be used in practice shall be used.

A1.1.4 Verify that the intensity stated in 6.1.1 is met in each of the rain gauges.

A1.2 Calibration of Uniformity of Drop-size

A1.2.1 Fill four pie pans with sifted flour and strike off with a ruler to produce a smooth, uncompacted surface.

A1.2.2 Place the pie pans in a holding container and cover with a waterproof lid or canopy.

A1.2.3 Turn on the rain simulator and allow it to reach a steady rate of rainfall. Remove the waterproof cover briefly to let drops impinge on the flour to form pellets.

A1.2.4 Replace the cover after only a few seconds before the pellets start to touch each other.

A1.2.5 Air-dry the flour-filled pans for a minimum of 12 hours.

A1.2.6 Screen the semi-dry pellets by emptying the entire contents of the pans onto a 70 mesh sieve in order to carefully remove as much loose flour as possible.

A1.2.7 Transfer the remaining pellets to evaporating dishes and heat in an oven at 43°C (110°F) for 2 hours.

A1.2.8 Weigh the total mass of the hard flour pellets.

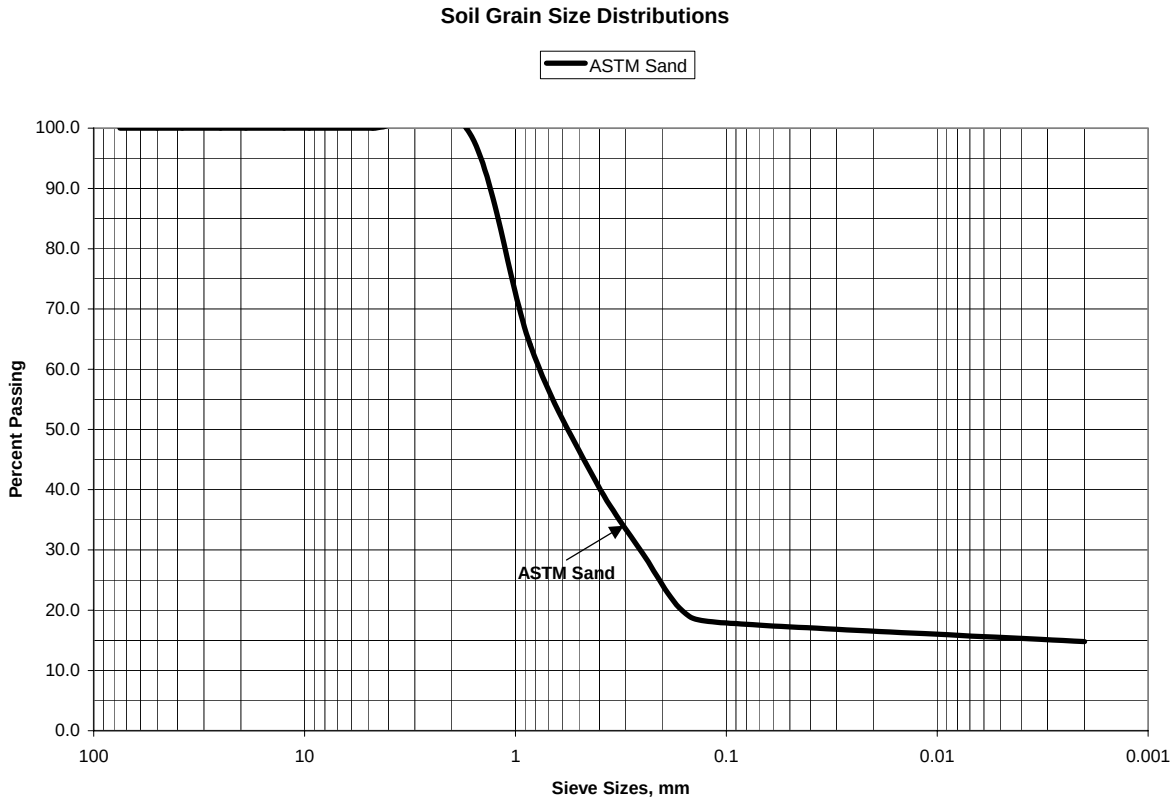
A1.2.9 Pour the pellets through standard soil sieves and shake the stack for 2 minutes. Foreign matter and any double pellets are culled from each sieve and the total weight for each size is recorded.

A1.2.10 Verify that the distribution of pellet sizes meets the conditions of 6.1.1.

A2.0 Standard Soils

A2.1 General soil type to be used for testing shall be sand. The sand shall comply with the sand gradation given in ASTM D 6460. The target gradation curve for the sand is included in Figure 1. The sand layers shall be compacted to approximately 90 percent of Standard Proctor density per ASTM D 698.

A2.2 If the RECP is to be soil filled, the additional cover soil is placed and compacted after the RECP placement.



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