



Designation: D 6459 – 99

Standard Test Method for Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion¹

This standard is issued under the fixed designation D 6459; 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 covers the guidelines, requirements and procedures for evaluating the ability of Erosion Control Blankets (ECBs) to protect hillslopes from rainfall-induced erosion. Critical elements of this protection are the ability of the ECB to:

1.1.1 Absorb the impact force of raindrops, thereby reducing soil particle loosening through “splash” mechanisms;

1.1.2 Slow runoff and encourage infiltration, thereby reducing soil particle displacement and transport through “overland flow” mechanisms;

1.1.3 Absorb shear forces of overland flow; and,

1.1.4 Trap soil particles beneath.

1.2 This test method utilizes full-scale testing procedures, rather than reduced-scale (bench-scale) simulation, and is patterned after conditions typically found on construction sites at the conclusion of earthwork operations, but prior to the start of revegetation work. Therefore this considers only unvegetated conditions.

NOTE 1—Future revisions may consider partial or fully vegetated conditions.

1.3 This test method provides a comparative evaluation of an ECB to baseline bare soil conditions under controlled and documented conditions.

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 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.* Also, the user must comply with prevalent regulatory codes, such as OSHA (Occupational Health and Safety Administration) guidelines, while using the test method.

2. Referenced Documents

2.1 *ASTM Standards:*

C 136 Test Method for Sieve Analysis of Fine and Course Aggregates²

D 422 Test Method for Particle-Size Analysis of Soils³

D 698 Test Method for Laboratory Characteristics of Soil Using Standard Effort⁴

D 2974 Standard Test Methods for Moisture, Ash, and Organic Matter of Peat and Other Organic Soils³

D 4318 Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils³

3. Terminology

3.1 *Definitions of Terms Specific to This Standard:*

3.1.1 *erosion control blanket (ECB), n*—a degradable material, composed primarily of processed natural organic materials, manufactured or fabricated into rolls designed to reduce soil erosion and assist in the growth, establishment and protection of vegetation.

3.1.2 *erosion control net (ECN), n*—a planar woven natural fiber or extruded synthetic mesh used as a component in the manufacture of ECBs.

3.1.3 *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.

3.1.4 *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.

3.1.5 *natural, n*—a class name of various fibers of animal, mineral or vegetable origin.

3.1.6 *open weave textile (OWT), n*—a temporary degradable ECB composed of natural or polymer yarns woven into a matrix used to provide erosion control and facilitate vegetation establishment.

¹ This test method is under the jurisdiction of ASTM Committee D-18 on Soil and Rock; Subcommittee D18.25 on Erosion and Sediment Control Technology; and is the direct responsibility of Section .02 on Erosion Control Blankets (ECBs).

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² *Annual Book of ASTM Standards*, Vol 04.02.

³ *Annual Book of ASTM Standards*, Vol 04.08.

⁴ *Annual Book of ASTM Standards*, Vol 15.09.

3.1.7 *polymer, n*—a chemical compound or mixture of compounds formed by polymerization and consisting essentially of repeating molecular structural units.

3.1.8 *sample, n*—a portion of material which is taken for testing or documentation and used in the laboratory as a source of individual specimens.

3.1.9 *temporary degradable, adj*—composed of biologically, photochemically or otherwise degradable materials that temporarily reduce soil erosion and enhance the establishment of vegetation.

4. Summary of Test Method

4.1 The performance of an erosion control blanket in reducing rainfall-induced erosion is determined by subjecting the material to simulated rainfall in a controlled and documented environment.

4.2 Key elements of the testing process include:

- 4.2.1 Calibration of the rainfall simulation equipment;
- 4.2.2 Preparation of the test plot;
- 4.2.3 Documentation of the ECB to be tested;
- 4.2.4 Installation of the ECB;
- 4.2.5 Performance of the test;
- 4.2.6 Collection of runoff and associated sediment yield data;
- 4.2.7 Analysis of the resultant data, and;
- 4.2.8 Reporting.

5. Significance and Use

5.1 This test method evaluates ECBs and their means of installation to:

5.1.1 Reduce soil loss and sediment concentrations in stormwater runoff under conditions of varying rainfall intensity and soil type, and;

5.1.2 Improve water quality exiting the area disturbed by earthwork activity by reducing suspended solids.

5.2 This test method models and examines conditions typically found on construction sites involving earthwork activities including: highway and roads; airports; residential, commercial and industrial developments; pipelines, mines, and landfills; golf courses; etc.

5.3 This test method is a performance test, but can be used for quality control to determine product conformance to project specifications. Caution is advised since information about between-laboratory precision is incomplete. Unique project-specific conditions should be taken into consideration.

6. Apparatus

6.1 *Rainfall Simulators*—Rainfall simulators shall include sprinkler heads, sprinkler risers, valves and pressure gages. The sprinkler heads should be selected on their ability to model natural raindrop size and distribution (no more than 10 % greater than 6 mm (0.24 in.) and no more than 10 % smaller than 1 mm (0.04 in.)). To approximate the kinetic energy of natural rainfall, the sprinkler riser shall be constructed to position the sprinkler heads to achieve a minimum fall height (peak vertical trajectory) of 4.3 m (14 ft). A flow control valve and a pressure gauge capable of maintaining a uniform operating pressure shall be located on each riser. Fig. 1 shows an example of a rainfall simulator.

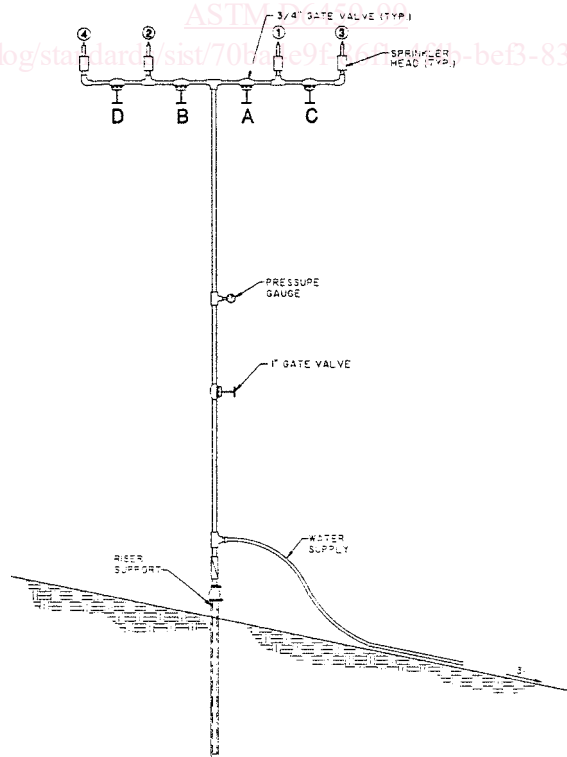


FIG. 1 Typical Rainfall Simulator

6.2 *Water Source*—Any water source shall be suitable for this use provided that it does not contain deleterious materials which could impair the operation of the rainfall simulators.

6.3 *Runoff and Sediment Collection System*—The runoff and sediment collection system includes flashing, collection apparatus and a holding tank. Flashing shall be fabricated to direct runoff from the plot into the collection apparatus. Once the runoff is on the flashing, it may be desirable to divert the flow to a single collection point. The flashing shall be continuous across the entire bottom edge of the plot. A holding tank(s) capable of temporarily containing all runoff shall be connected to the collection apparatus.

6.4 *Miscellaneous*—Other miscellaneous equipment includes: rain gauges (20), pie pans (3), sieve set (standard US sieves), evaporating dishes, a drying oven or microwave oven, balances, meteorological equipment (wind speed, temperature, precipitation), a surveyor's rod, sample bottles and bags, cooler and camera or video recorder.

7. Procedure

7.1 Test Plot Preparation:

7.1.1 Construct an earthen embankment using conventional earthwork placement techniques. Perform compaction of the embankment to create a geotechnically (structurally) stable embankment with a surface slope of 3H:1V having a slope length of 12 m (40 ft). Fig. 2 shows a typical embankment cross-section.

7.1.2 Plate the top surface of the embankment with a minimum 15 cm (6 in.) thick veneer of soil. General soil types to be used for testing shall be loam, clay and sand. The target gradation curves for the loam and sand soil types is included in Fig. 3 and Fig. 4. The target plastic indices (PI) for the loam and clay soil types shall be approximately 4.5 and 15.0 ± 2.0 and 5.0, respectively. Place the veneer in 15 cm (6 in.) lifts and compact to approximately 90 to 95 % of standard proctor density in accordance with Test Method D 698.

7.1.3 Locate test plots on the embankment using a plot size of 2.4 m (8 ft) in width (cross-slope) and of 12 m (40 ft) in length (downslope). Separate the test plots such that overspray from the rainfall simulators does not impact adjacent plots.

NOTE 2—The slope width, length and steepness were selected as being representative of conditions typically found on construction sites. This test plot configuration was chosen to assure uniformity and consistence of testing activities.

7.1.4 Isolate the top edge and sides of each test plot by a water barrier which forms the boundary of the test plot. Bury the bottom edge of the barrier approximately 10 cm (4 in.) to divert surface flow such that no intrusion of outside surface

water onto the test plot (“run-on”) occurs. The barrier shall be continuous such that joints do not allow outside flow to enter the plot. Commercially available lawn edging is suitable for this purpose.

7.1.5 Loosen the soil veneer to a depth of approximately 10 cm (4 in.) using a tiller or other appropriate tools. Rake the tilled plot smooth with a steel hand rake and lightly compact using a turf roller. Repair depressions, voids, soft, or uncompacted areas before testing commences. Also, free the plot from obstruction or protrusions, such as roots, large stones, or other foreign material.

7.1.6 If the plots have been used for previous test series, discard the soil carried off the plot and obliterate any rills and gullies. Spread new soil of the same type across the plot and blend (rake or till) into the surface. If the soil loss of the control plot differs significantly from the base line calibration test reevaluate the soil properties.

7.2 Calibration:

7.2.1 Calibration of the rainfall simulation equipment includes:

7.2.1.1 Rainfall intensity;

7.2.1.2 Uniformity of rainfall application across the plot, and;

7.2.1.3 Drop size distribution for each intensity.

7.2.2 To ensure uniform distribution, do not conduct calibration and testing when the wind velocity is greater than 8 km/h (5 mph).

7.2.3 At a minimum, conduct calibration annually or following equipment maintenance work. Conduct one intensity/uniformity check every 90 days, or after no more than four test series, whichever comes first.

7.2.4 Place sprinkler risers around the perimeter of the test plot to provide uniform distribution. The precise location of the risers to provide uniform rainfall distribution will be determined by the calibration process and the nuances of any given simulator system (See Fig. 5 for typical sprinkler riser configuration.).

7.2.5 Place the rain gages on the plot surface following the pattern shown in Fig. 5. Duration of the calibration test shall be 15 min, recorded to the nearest second. Perform calibrations at uniform pressure for each intensity. Adjust riser locations until an acceptable uniform rainfall distribution pattern is achieved, as defined in Section 8.

7.2.6 Calculate the rainfall intensity uniformity using the Christiansen uniformity coefficient (see Section 8).

7.2.7 To measure drop size distribution, completely fill three labeled pie pans with sifted flour, struck off with a ruler to produce a smooth, uncompacted surface. Locate three supports

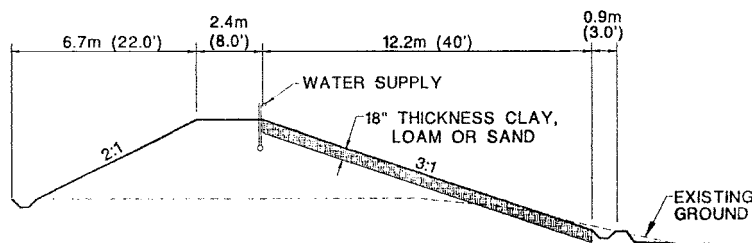


FIG. 2 Typical Embankment Cross Section

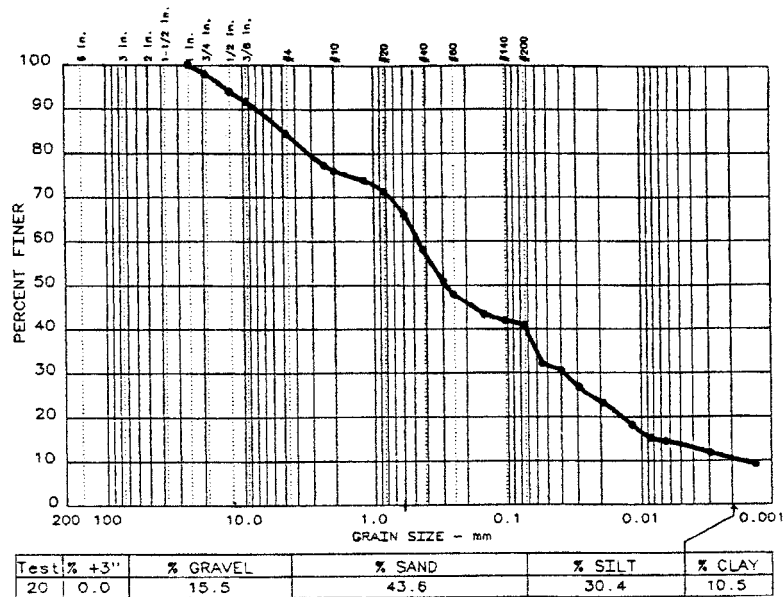


FIG. 3 Typical Loam Grain Size Distribution

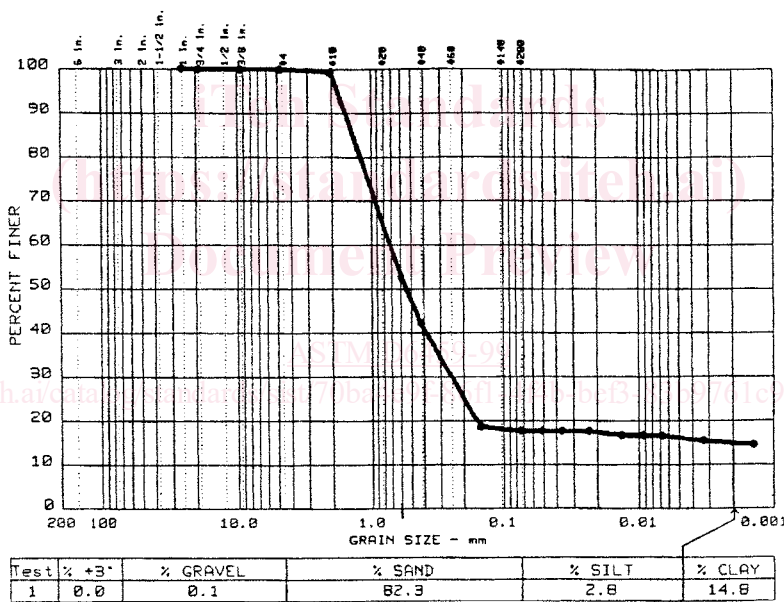


FIG. 4 Typical Sand Grain Size Distribution

approximately 20-cm (8-in.) high (for example, 1-gal cans) along the vertical centerline of the test plot, and at the horizontal quarter points. Place the filled pie pans on the supports (horizontal, not parallel to the ground) and cover. At the desired test intensity, remove the cover briefly so that drops impinge on the flour to form pellets. Recover the pans after only a few seconds and before the drops start to touch each other. Repeat this procedure at each desired intensity. Air-dry the flour pellets for a minimum of 12 h. Screen each sample of these semi-dry pellets by emptying the entire contents of the pan onto a 70 mesh sieve to carefully remove as much loose flour as possible. Then transfer the remaining pellets to evaporating dishes and heat in an oven at approximately 43°C (110°F) for 2 h. Record the total weight of the hard flour pellets. Sieve the pellets through standard soil sieves by

shaking the stack for 2 min. Cull foreign matter and any double pellets from each sieve and record the total weight and pellet count for each size. (1)⁵

7.2.8 Repeat the raindrop size calibration procedure (7.2.7) three times for each desired intensity.

7.2.9 Determine raindrop fall height by measuring the average height of the raindrop trajectory using a surveyor's rod. Hold the rod vertically in the spray of a single riser and measure the wetted height. Repeat the height measurement for each desired intensity.

7.3 Pre-Test Documentation:

⁵ The boldface numbers given in parentheses refer to a list of references at the end of the text.