Designation: D5101 – 23

Standard Test Method for Measuring the Filtration Compatibility of Soil-Geotextile Systems[1]

This standard is issued under the fixed designation D5101; 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 performance tests applicable for determining the compatibility of geotextiles with various types of water-saturated soils under unidirectional flow conditions.

1.2 Two evaluation methods may be used to investigate soil-geotextile filtration behavior, depending on the soil type:

1.2.1 For soils with a plasticity index lower than 5, the systems compatibility shall be evaluated per this standard.

1.2.2 For soils with a plasticity index of 5 or more, it is recommended to use Test Method D5567 ('HCR,' Hydraulic Conductivity Ratio) instead of this test method.

1.2.3 If the plasticity index of the soil is close to 5, the involved parties shall agree on the selection of the appropriate method prior to conducting the test. This task may require comparison of the permeability of the soil-geotextile system to the detection limits of the HCR and Gradient Ratio Test (GRT) test apparatus being used.

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

1.4 *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.*

1.5 *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:*[2]

D123 Terminology Relating to Textiles

D422 Test Method for Particle-Size Analysis of Soils (Withdrawn 2016)[3]

D653 Terminology Relating to Soil, Rock, and Contained Fluids

D4318 Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

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

D4439 Terminology for Geosynthetics

D5567 Test Method for Hydraulic Conductivity Ratio (HCR) Testing of Soil/Geotextile Systems

3. Terminology

3.1 *Definitions:*

3.1.1 *clogging, n—in geotextiles*, the tendency for a given geotextile to lose permeability due to soil particles that have either become embedded in the fabric openings or have built up on the geotextile surface to form a layer with lower permeability than that of the bulk soil specimen.

3.1.2 *gradient ratio, n—in geotextiles*, ratio of the hydraulic gradient across a soil-geotextile interface to the hydraulic gradient through the soil alone.

3.1.3 *hydraulic gradient, i, s (D)*—the loss of hydraulic head per unit distance of flow, dH/dL.

3.1.4 *piping, n*—the tendency of the geotextile to let a quantity of soil pass through its plane that may potentially lead to stability concerns in the soil or internal clogging of the geotextile.

[1] This test method is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.03 on Permeability and Filtration.

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[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.

[3] The last approved version of this historical standard is referenced on www.astm.org.

3.1.5 For definitions of other textile terms, refer to Terminology D123. For definitions of other terms related to geotextiles, refer to Terminology D4439 and Terminology D653.

3.2 *Acronyms:*

3.2.1 *CHD*—the acronym for constant head device

3.2.2 *GRT*—the acronym for gradient ratio test

3.2.3 *HCR*—the acronym for hydraulic conductivity ratio

4. Summary of Test Method

4.1 This method is intended for use in the observation of change in the permeability of a soil-geotextile interface over time under a range of applied hydraulic gradients. At the end of the test, the weight of soil passing through the geotextile is measured. The distribution of hydraulic gradients in the vicinity of the soil-geotextile interface is also observed.

5. Significance and Use

5.1 This test method is recommended for the evaluation of the performance of water-saturated soil-geotextile systems under unidirectional flow conditions. The results obtained may be used as an indication of the compatibility of the soil-geotextile system with respect to both particle retention and flow capacity.

5.2 This test method is intended to evaluate the performance of specific on-site soils and geotextiles at the design stage of a project, or to provide qualitative data that may help identify causes of failure (for example, clogging, particle loss). It is not appropriate for acceptance testing of geotextiles. It is also improper to utilize the results from this test for job specifications or manufacturers' certifications.

5.3 This test method is intended for site-specific investigation therefore is not an index property of the geotextile, and thus is not intended to be requested of the manufacturer or supplier of the geotextile.

6. Apparatus and Supplies

6.1 *Soil-Geotextile Permeameter*—A typical permeameter will consist of three units, shown in Fig. 1, set up on a frame incorporating the other components such as the structure shown in Fig. 2. The lower unit will contain a soil-geotextile support screen and an outflow reservoir that permits collection of the particles passing through the geotextile during different stages of the test. The middle unit will hold the soil specimen and should be equipped with a piping barrier (for example, caulk) along the interface between the geotextile and the permeameter walls. The geotextile support screen opening size shall be greater than ten times the measured AOS of the geotextile. The upper unit will permit application of a constant head boundary condition to the top of the specimen. The permeameter should also be equipped with a support stand, clamping brackets, and plastic tubing to connect with an external pressure head monitoring system.

NOTE 1—The diameter of the permeameter shall be at least 10 × d100, where d100 is the largest particle of soil placed in the permeameter. In the case soils with particles larger than 16 mm (mesh No. ⅝ in.) were to be evaluated, only the fraction smaller than 16 mm shall be used for testing.

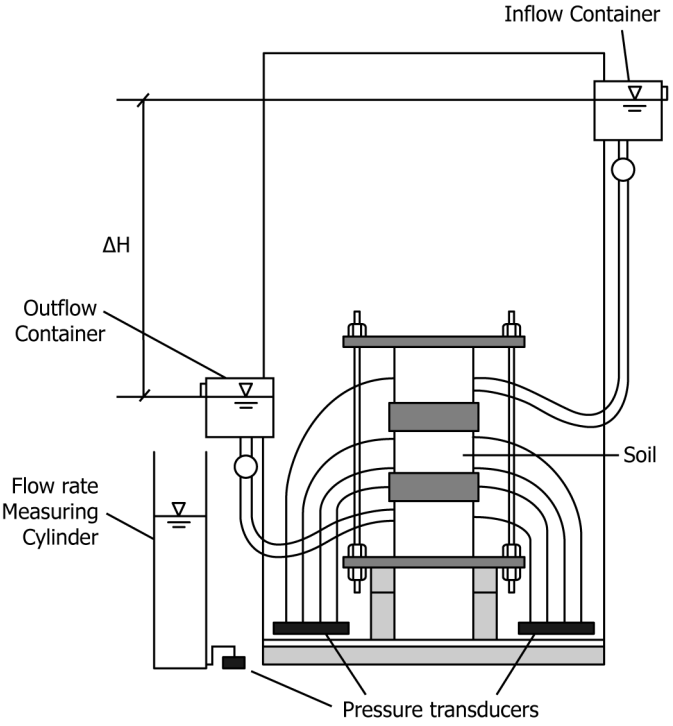

FIG. 1 Gradient Ratio Test Setup

NOTE 2—Some permeameters allow application of a normal load on the soil-geotextile interface. If so, the loading system shall be designed in such a way that it will not influence the system's hydraulic behavior.

6.2 *Two Constant Water Head Devices,* one mounted on a jack stand (adjustable) and one stationary (Fig. 3).

6.3 *Soil Leveling Device* (Fig. 4).

6.4 *Manometer Board,* of parallel glass tubes and measuring rulers.

6.5 *Two Soil Support Screens,* of approximately 5 mm (No. 4) mesh.

6.6 *Soil Support Cloth,* of 150 µm (No. 100) mesh, or equivalent geotextile.

6.7 *Thermometer* (0 to 50 ± 1 °C).

6.8 *Graduated Cylinder,* 100 ± 1 cm^3 capacity.

6.9 *Stopwatch.*

6.10 *Balance,* or scale of at least 2 kg capacity and accurate to ±1 g.

6.11 *Carbon Dioxide,* (CO_2), gas supply and regulator.

6.12 *Geotextile.*

6.13 *Water Recirculation System.*

6.14 *Water Deairing System,* with a sufficient capacity to avoid recirculation of water in the test, which may replace fine particles that have washed out of the specimen. Typical capacity: 1700 L/day (500 gal/day).

6.15 *Algae Inhibitor,* or micro screen.

6.16 *Computer,* with data acquisition card.

6.17 *Pressure Transducers,* accurate to ±1 mm or ±1 %, whichever is larger, used for measurements of the head