Designation: D 6574 – 00

Test Method for Determining the (In-Plane) Hydraulic Transmissivity of a Geosynthetic by Radial Flow[1]

This standard is issued under the fixed designation D 6574; 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 procedure for determining the in-plane transmissivity of geosynthetics under varying normal compressive stresses using a radial flow apparatus. The test is intended to be an index test used primarily for geotextiles, although other products composed of geotextiles and geotextile-type materials may be suitable for testing with this test method.

1.2 This test method is based on the assumption that the transmissivity of the geosynthetic is independent of orientation of the flow and is therefore limited to geosynthetics that have similar transmissivity in all directions and should not be used for materials with oriented flow behavior.

1.3 This test method has been developed specifically for geosynthetics that have transmissivity values on the order of or less than 2×10^{-4} m^2/s. Consider using D 4716 for geosynthetics with transmissivity values higher than 2×10^{-4} m^2/s.

1.4 The values stated in SI units are to be regarded as the standard. The values stated in parentheses are provided for information 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.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 4354 Practice for Sampling of Geosynthetics for Testing[2]
D 4439 Terminology for Geotextiles[2]
D 4491 Test Methods for Water Permeability of Geotextiles by Permittivity[2]
D 4716 Test Method for Determining the Flow Rate per Unit Width of a Geosynthetic Using a Constant Head[2]

3. Terminology

3.1 *Definitions:*

For definitions of terms relating to geosynthetics, refer to Terminology D 4439.

3.1.2 *geosynthetic*, *n*—a planar product manufactured from polymeric material used with soil, rock, earth, or other geotechnical engineering related material as an integral part of a man-made project, structure, or system. **(D 4439)**

3.1.3 *geotextile*, *n*—a permeable geosynthetic comprised solely of textiles. **(D 4439)**

3.1.4 *gravity flow*, *n*—flow in a direction parallel to the plane of a geosynthetic driven predominantly by a difference in elevation between the inlet and outflow points of a specimen. **(D 4439)**

3.1.4.1 *Discussion*—The pressure at the outflow is considered to be atmospheric.

3.1.5 *head (static)*, *n*—the height above a standard datum of the surface of a column of water (or other liquid) that can be supported by a static pressure at a given point. The static head is the sum of the elevation head and the pressure head. **(D 5092)**

3.1.6 *hydraulic gradient*, *i*, *s (D)*, *n*—the loss of hydraulic head per unit distance of flow, dH/dL. **(D 4439)**

3.1.6.1 *Discussion*—The gradient is not constant from point to point in the direction of flow in the radial flow test. The gradient (mathematically) varies with the inverse of the radial distance from the center.

3.1.7 *hydraulic transmissivity*, θ (L^2 T^{-1}), *n*—for a geosynthetic, the volumetric flow rate per unit width of specimen per unit gradient in a direction parallel to the plane of the specimen. **(D 4439)**

3.1.7.1 *Discussion*—Transmissivity is technically applicable only to saturated laminar flow hydraulic conditions.

3.1.8 *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. **(D 4439)**

3.1.9 *in-plane flow*, *n*—fluid flow confined to a direction parallel to the plane of a geosynthetic. **(D 4439)**

3.1.10 *laminar flow*, *n*—flow in which the head loss is proportional to the first power of the velocity. **(D 4439)**

3.1.11 *normal stress*, (FL^{-2}), *n*—the component of applied stress that is perpendicular to the surface on which the force acts. **(D 4439)**

3.1.12 *turbulent flow*, *n*—that type of flow in which any water particle may move in any direction with respect to any other particle and in which the head loss is approximately proportional to the second power of the velocity. **(D 4439)**

[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] *Annual Book of ASTM Standards*, Vol 04.09.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *steady flow, n*—hydraulic flow conditions that do not vary with time at any given point.

3.2.2 *uniform flow, n*—hydraulic flow conditions where the cross-sectional area and the mean velocity in the direction of flow are constant from point to point.

4. Summary of Test Method

4.1 The transmissivity is determined using a device which transmits the flow of water radially outward from the center of a torus-shaped test specimen. The test method is performed with a constant head under a specific normal stress selected by the user and may be repeated using several gradients and under increasing normal stresses.

4.2 The material property "hydraulic transmissivity" is technically applicable only to the regions of tests where the flow rate is constant with gradient, that is, the laminar region of the tests.

4.3 In the constant head radial flow test, the flow regime is characterized as nonuniform steady flow since the cross-sectional flow area and the hydraulic gradient vary from point to point along any radial flow line while remaining constant with time.

5. Significance and Use

5.1 This test method is an index test to estimate and compare the in-plane hydraulic transmissivity of one or several candidate geosynthetics under specific gradient and stress conditions.

5.2 This test method may be used for acceptance testing of commercial shipments of geosynthetics, but caution is advised since information about between-laboratory precision is incomplete. Comparative tests as directed in 5.2.1 are advisable.

5.2.1 In case of a dispute arising from differences in reported test results when using this procedure for acceptance of commercial shipments, the purchaser and the supplier should first confirm that the tests have been conducted using comparable test parameters including specimen conditioning, normal stress, hydraulic system gradient, etc. Comparative tests then should be conducted to determine if there is a statistical bias between their laboratories. Competent statistical assistance is recommended for the investigation of bias. As a minimum, the two parties should take a group of test specimens that are as homogeneous as possible and that are formed from a lot of the material in question. The test specimens should be assigned randomly to each laboratory for testing. The average results from the two laboratories should be compared using the Student's *t*-test for unpaired data and an acceptable probability level chosen by the two parties before testing is begun. If bias is found, either its cause must be found and corrected or the purchaser and supplier must agree to interpret future test results in light of the known bias.

6. Apparatus

6.1 A schematic drawing of a typical constant head assembly is shown in Fig. 1. The individual components and accessories are as follows:

6.1.1 *Base*—The bottom section of the apparatus should be constructed of a sturdy metal or plastic plate with a smooth, flat contact surface. The center inlet hole shall be 50 mm (2 in). The outside dimension of the base must match or exceed the outside diameter of the test specimen. A manometer tap should be located in the sidewall of the inlet opening.

6.1.2 *Perimeter Containment/Outlet Weir*—A perimeter ring concentric with the outside diameter of the test specimen with sufficient height to contain the tail water, such that the specimen remains submerged under water at all times during the test. The containment ring should double as the overflow wier, with a beveled edge around the perimeter, with an outer concentric collection trough for collection of the overflow. Alternatively, the containment ring may include a rectangular overflow weir at one location in the ring that is at least 2.5 cm wide with a beveled overflow plate.

6.1.3 *Loading Platen*—A sturdy circular metal or plastic

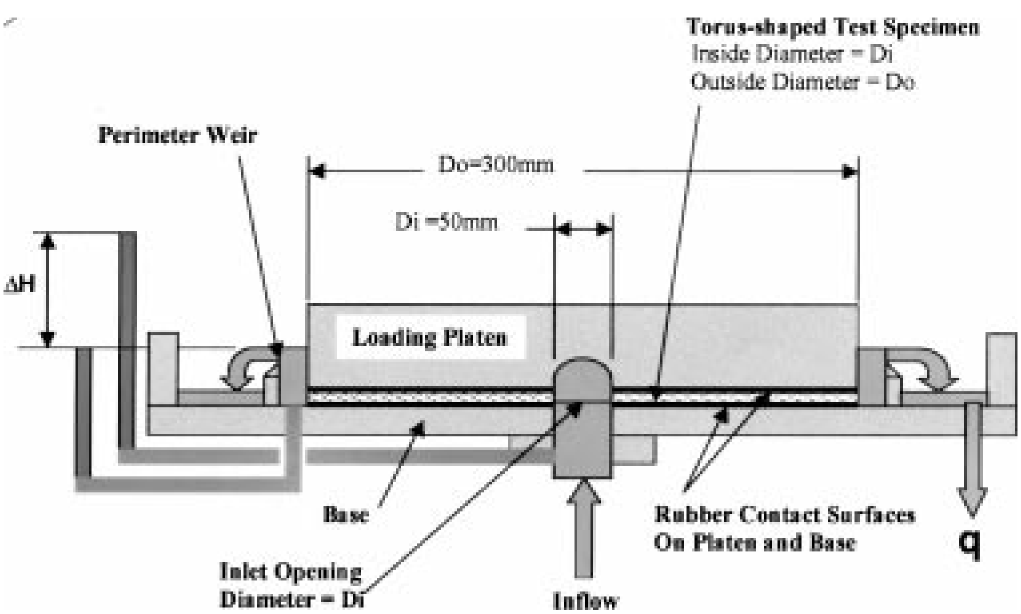

FIG. 1 A Radial Transmissivity Constant Head Testing Device