Designation: D 5493 – 93 (Reapproved 1998)

Standard Test Method for Permittivity of Geotextiles Under Load[1]

This standard is issued under the fixed designation D 5493; 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 determination of the water permittivity behavior of geotextiles in a direction normal to the plane of the geotextile when subjected to specific normal compressive loads.

1.2 Use of this test method is limited to geotextiles. This test method is not intended for application with geotextile-related products such as geogrids, geonets, geomembranes, and other geocomposites.

1.3 The values stated in SI units are to be regarded as the standard. The inch-pound units given 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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 *ASTM Standards:*

D 123 Terminology Relating to Textile Materials[2]

D 653 Terminology Relating to Soil, Rock, and Contained Fluids[3]

D 4354 Practice for Sampling of Geosynthetics for Testing[4]

D 4439 Terminology for Geosynthetics[4]

D 4491 Test Method for Water Permeability of Geotextiles by Permittivity[4]

D 4716 Test Method for Determining the (in-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head[4]

3. Terminology

3.1 *Definitions:*

3.1.1 *geotextile, n*—any permeable textile material used with foundation, soil, rock, earth, or any other geotechnical engineering related material as an integral part of a manmade project, structure, or system (see Terminology D 4439).

3.1.2 *hydraulic gradient, i, n*—the loss of hydraulic head per unit distance of flow, dh/dL (see Test Method D 4716).

3.1.3 *permittivity, (ψ), (T^{-1}), n*—of geotextiles, the volumetric flow rate of water per unit cross-sectional area per unit head under laminar flow conditions, in the normal direction through a geotextile (see Terminology D 4439).

3.1.4 *For the definitions of other terms relating to geotextiles, refer to Terminology D 4439. For the definitions of textile terms, refer to Terminology D 123. For the definitions of coefficient of permeability, refer to Terminology D 653.*

4. Summary of Test Method

4.1 This test method provides a procedure for measuring the water flow, in the normal direction through a known cross section of a single layer of a geotextile at predetermined constant hydraulic heads over a range of applied normal compressive stresses.

4.2 The permittivity of a geotextile, ψ, can be determined by measuring the flow rate of water, in the normal direction, through a known cross section of a geotextile at predetermined constant water heads.

4.3 Water flow through geotextiles can be laminar, transient, or turbulent, and therefore permittivity cannot be taken as a constant.

5. Significance and Use

5.1 The thickness of a geotextile decreases with increase in the normal compressive stress. This decrease in thickness may result in the partial closing or the opening of the voids of geotextile depending on its initial structure and the boundary conditions.

5.2 This test method measures the permittivity due to a change of void structure of a geotextile as a result of an applied compressive stress.

6. Apparatus

6.1 The apparatus used for the normal permeability under load test is shown in Fig. 1. The apparatus shall conform to one of the following arrangements:

6.1.1 The apparatus must be capable of maintaining a constant head of water on the geotextile specimens being tested.

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[1] This test method is under the jurisdiction of ASTM Committee D-35 on Geosynthetics and is the direct responsibility of Subcommittee D35.03 on Permeability and Filtration.

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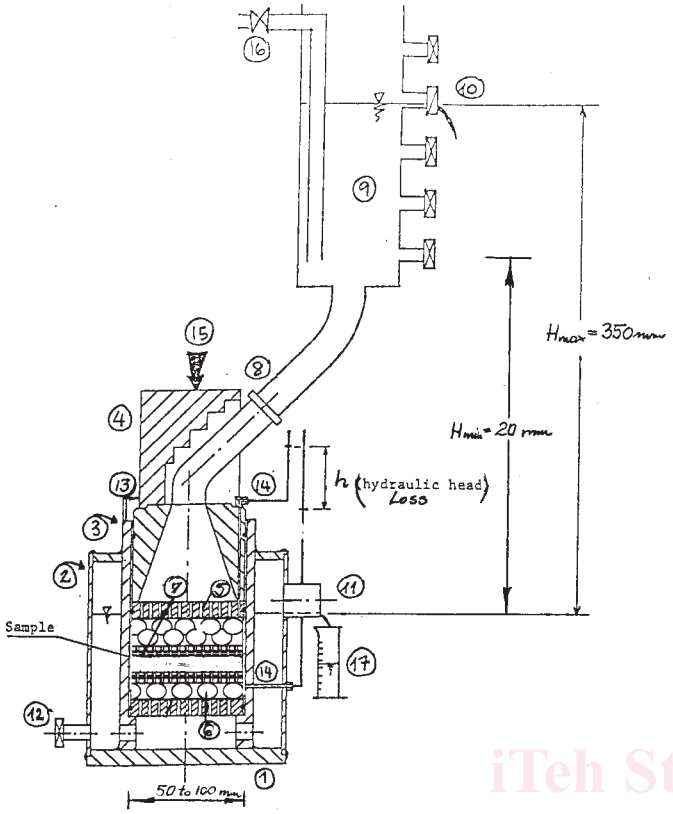
[2] *Annual Book of ASTM Standards*, Vol 07.01.

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

[4] *Annual Book of ASTM Standards*, Vol 04.13.



NOTE—Not at scale.

FIG. 1 Schematic View of the Apparatus

6.1.2 The apparatus must not be the controlling factor for flow during the test. It will be necessary to establish a calibration curve of flow rate versus hydraulic head for the apparatus alone in order to establish compliance with this requirement (see appendix).

6.2 The apparatus consists of a stand (*1*) and a water tank (*2*) on which sits a vertical cylinder (*3*), a piston (*4*) used for the application of the normal loads in the range from 2 to 200 kPa (0.28 to 28 psig) with an accuracy of ±2 µPa (±0.28 psig), two perforated plates used as water distributors (*5*), two glass or ceramic balls layers (*6*), two layers of wire mesh (*7*), a water inlet (*8*) connected to a reservoir containing deaired water (*9*), overflow outlets at both the upper reservoir (*10*) and lower water tank (*11*), a drainage or discharge valve (*12*), a scale to measure changes of thickness of test specimen (*13*) and piezometers (*14*).

6.3 The overflow (*11*) located in the water tank (*2*) must be located above the geotextile specimen installed in the cylinder (*3*). The recommended tubing diameter is 25 mm.

6.4 The reservoir (*9*) contains a number of overflow outlets to enable setting of different hydraulic heads. The range of possible hydraulic heads should be between 20 to 350 mm. The hydraulic head is defined as the difference between the water level at overflow (*10*) and the water level at the outlet overflow (*11*).

6.5 The geotextile specimen is installed in the cylinder (*3*) in between two wire meshes (*7*) and balls layers (*6*) and upper and lower perforated plates (*5*).

6.6 Once the specimen, the balls, and the plates are secured in the cylinder (*3*), remaining parts must be assembled on the apparatus, that is:

6.6.1 Piezometers (*14*) are used to measure hydraulic head losses at geotextile interfaces;

6.6.2 Part (*15*) allows setting of the load on the piston (*4*);

6.6.3 A valve (*16*) allows a constant flow of deaired water; and

6.6.4 A graduated collection vessel (*17*) allows collecting of the discharge water that flows through the specimen.

6.7 Certain required dimensions of the apparatus are shown in Fig. 1.

7. Sampling

7.1 *Lot Sample*—As a lot sample for acceptance testing, take at random the number of rolls of geotextile directed in an applicable material specification or other agreement between the purchaser and the supplier. Consider rolls of geotextile to be the primary sampling units. If the specification requires sampling during manufacture, select the rolls for the lot sample at uniformly spaced time intervals throughout the production period.

NOTE 1—An adequate specification or other agreement between the purchaser and the supplier requires taking into account the variability between rolls of geotextile and between specimens from a swatch from a roll of geotextile so as to provide a sampling plan with a meaningful producer's risk, consumer's risk, acceptable quality level, and limiting quality level.

7.2 *Laboratory Sample*—Consider the units in the lot sample as the units in the laboratory sample. Take a sample that will exclude material from the outer wrap of the roll or the inner wrap around the core unless the sample is taken at the production site, at which point the inner and outer wrap material may be used.

8. Test Water Preparation

8.1 De-air the test water to provide reproducible test results.

8.2 De-air the water used for saturation.

8.3 De-air the water under a vacuum of 710 mm (28 in.) of mercury (Hg) for the period of time to bring the dissolved oxygen content down to a maximum of 6 ppm.

8.4 Use dissolved oxygen meter or commercially available chemical kits to determine the dissolved oxygen content.

8.5 The deaired system may be a commercially available system, or one consisting of a vacuum pump capable of removing a minimum of 150 L/min of air in connection with a non-collapsible storage tank with a large enough storage capacity for the test series, or at least one specimen at a time. Allow the deaired water to stand in closed storage under a slight vacuum until room temperature is attained.

8.6 If water temperature other than 20°C is being used, make a temperature correction to the resulting value of permittivity.

8.7 Determine the temperature correction factor using the following equation:

$$Rt = ut/u20 \quad (1)$$

where: