



# Permeability or permittivity? What should be specified?

**T**he state of geosynthetic specification has come a long way from ASTM's long-standing test methods. ASTM Committee D-35 has developed specific test methods for survivability, transmissivity, abrasion resistance and field seams of flexible membrane liners. Most of these test methods are index test methods.

Index test methods allow the designer to compare the performance of geosynthetics, tested under the same, controlled, highly repeatable conditions, so that a selection can be made between products. This paper will discuss the difference between permeability and permittivity and show why permittivity should be specified as the correct index test value for cross-plane flow rate.

## Specification functions

A specification should do two things:

- Define a project's needs by listing the required properties that assure the selected product will serve its intended function and perform properly during construction, as well as, throughout the design life of the project.
- Define the product using standard test methods that will allow the specifier to evaluate fairly, and compare, the different products submitted for approval.

On any project requiring permeable separation, a geotextile's cross-plane flow characteristic is an important consideration. One way to evaluate a geotextile's ability to perform this function is a long-term flow test that measures a product's filtration mechanism's performance with a site-specific soil. A second option is ASTM D-5101 (Measuring the Soil-Geotextile System Clogging Potential By the Gradient Ratio).

Both tests will provide the designer with valuable information to evaluate

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various geotextile products and their performance with on-site soils. Unfortunately, these test methods are not always practical—it takes a long time to get results, and the tests are expensive because multiple products must be tested. Also, the results of these test methods do not provide data for specification or certification.

The index test method ASTM D-4491 (Test Methods for Water Permeability of Geotextiles by Permittivity), does a good job of measuring a product's ability to pass water normal to the fabric. While this test method provides relevant cross-plane flow data for specification/certification purposes, it has been misused by modifying the test method to provide a permeability value by multiplying the index permittivity value times the thickness of the fabric.

Using a geotextile's permeability

	<b>Product A</b>	<b>Product B</b>
Flux (gal./min-ft <sup>2</sup> )	100	100
Permittivity (sec <sup>-1</sup> )	1.3	1.3
Thickness (mils)	20	100
Permeability (cm/sec)	0.66 × 10 <sup>-1</sup>	3.30 × 10 <sup>-1</sup>

value may seem to be a logical idea so that one can compare the geotextile to soil, but this destroys the validity of the index value. (See table.)

Fabrics vary in thickness. Adding thickness to the equation nullifies a designer's ability to compare fabrics because the permeability value for each fabric is directly related to the thickness of each fabric (see table). Permittivity is the correct index test method because it allows a designer to compare similar materials.

David Suits, chairman of ASTM D-35, wrote in ASTM Standardization News, 1986:

“The permittivity rather than Darcy's coefficient of permeability, was chosen for geotextiles for two reasons. First, in determining the coefficient of permeability, it is necessary to know the thickness of the specimen being tested. This would be difficult to determine under the conditions of the test. Second, permittivity is an indicator of the flow of the geotextile. While it is possible for two geotextiles to have the same coefficient of permeability, they may have different flow capacities.”

Suits' statement, “Permittivity is an indicator of the flow capacity of a geotextile,” defines exactly what a designer requires for his specification. Permittivity gives the designer a reliable index value. Adding a fabric's thickness to the equation does not make the fabric a “soil” or give one a design test value to compare to soil. Multiplying thickness times a geotextile's permittivity value only makes a good index test method into a bad index method, dependent on an irrelevant thickness factor.

Permeability values are for soil comparison. Since a geotextile is not a soil, permeability should not be used to compare geotextiles. Permittivity is the correct index test method for geotextile comparison. **G**