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Standard Guide for Selecting Test Methods for Experimental Evaluation of Geosynthetic Durability[1]

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1. Scope

1.1 This guide covers a designer/specifier through a systematic determination of those factors of the appropriate application environment that may affect the post-construction service life of a geosynthetic. Subsequently, test methods are recommended to facilitate an experimental evaluation of the durability of geosynthetics in a specified environment so that the durability can be considered in the design process.

1.2 This guide is not intended to address durability issues associated with the manufacturing, handling, transportation, or installation environments.

1.3 *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]

D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature

D1987 Test Method for Biological Clogging of Geotextile or Soil/Geotextile Filters

D2990 Test Methods for Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics

D4355/D4355M Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus

D4439 Terminology for Geosynthetics

D4594/D4594M Test Method for Effects of Temperature on Stability of Geotextiles

D4716/D4716M Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head

D4833/D4833M Test Method for Index Puncture Resistance of Geomembranes and Related Products

D4886 Test Method for Abrasion Resistance of Geotextiles (Sandpaper/Sliding Block Method)

D5101 Test Method for Measuring the Filtration Compatibility of Soil-Geotextile Systems

D5262 Test Method for Determining the Unconfined Tension Creep and Creep Rupture Behavior of Planar Geosynthetics Used for Reinforcement Purposes

D5322 Practice for Laboratory Immersion Procedures for Evaluating the Chemical Resistance of Geosynthetics to Liquids

D5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

D5496 Practice for In-Field Immersion Testing of Geosynthetics

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

D5721 Practice for Air-Oven Aging of Polyolefin Geomembranes

D5970/D5970M Test Method for Deterioration of Geotextiles from Outdoor Exposure

D6992 Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method

D7238 Test Method for Effect of Exposure of Unreinforced Polyolefin Geomembrane Using Fluorescent UV Condensation Apparatus

D7361 Test Method for Accelerated Compressive Creep of Geosynthetic Materials Based on Time-Temperature Superposition Using the Stepped Isothermal Method

D7406 Test Method for Time-Dependent Compressive Deformation Under Constant Pressure for Geosynthetic Drainage Products

G160 Practice for Evaluating Microbial Susceptibility of Nonmetallic Materials By Laboratory Soil Burial

[1] This guide is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.02 on Endurance Properties.

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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. Terminology

3.1 *Definitions:*

3.1.1 For definitions relating to geosynthetics used in this standard, refer to Terminology D4439.

4. Summary of Guide

4.1 The effects of a given application environment on the durability of a geosynthetic must be determined through appropriate testing. Selection of appropriate tests requires a systematic determination of the primary function(s) to be performed and the associated degradation processes that should be considered. This guide provides a suitable systematic approach.

4.2 Primary functions of geosynthetics are listed and defined in Table 1. With knowledge of the specific geosynthetic application area and end use, the corresponding primary function(s) is (are) identified. Table 2 gives degradation concerns as they relate to geosynthetic functions. Table 3 gives the environmental elements that relate to the various degradation processes and the currently available ASTM Committee D35 test method for the experimental evaluation of specific types of geosynthetic degradation. The following appendixes are included to provide background information:

X1. Application / End Use / Primary Function Tables
X2. Example of Test Method Selection Procedure

5. Significance and Use

5.1 Designers/specifiers of geosynthetics should evaluate geosynthetic durability as an integral part of the geosynthetic specification/selection process. This guide is intended to guide a designer/specifier through a systematic determination of degradation concerns based on the intended geosynthetic function or performance characteristic. This guide then provides a guide to select available test methods for experimentally evaluating geosynthetic durability and to identify areas where no suitable test exists.

5.2 This guide does not address the evaluation of degradation resulting from manufacturing, handling, transporting, or installing the geosynthetic.

6. Suggested Procedure

6.1 To utilize a structured procedure for selecting appropriate test methods, the geosynthetic designer/specifier must have knowledge of:

6.1.1 The intended geosynthetic application,

6.1.2 The end use of the geosynthetic via its primary function(s) or performance characteristic(s), or both,

6.1.3 The specific environment to which the geosynthetic will be exposed,

6.1.4 The types of geosynthetics that may or will be used, and

6.1.5 The duration or time of use (that is, service life).

6.2 With this knowledge, the designer/specifier follows the following procedure:

6.2.1 Identify the primary function(s) or performance characteristic(s), or both, to be performed by the geosynthetic in the specific application and end use intended. Functions and performance characteristics are defined in Table 1. (Tables for guidance in identifying primary function(s) and performance characteristics are given in Appendix X1.)

6.2.2 Using Table 2, identify the potential degradation process(es) that will almost always (denoted as "A") or sometimes (denoted as "S") be of concern when a geosynthetic performs the primary function(s) or provides the performance characteristic(s), or both, which were identified in 6.2.1.

6.2.3 Using Table 3, select the test method(s) that applies to the potential degradation process(es) identified in 6.2.2 as a concern(s) in the specific application environment expected.

NOTE 1—Guidance is given in Table 3 to identify the most important elements or variables relating to each degradation process.

7. Keywords

7.1 aging; degradation; durability; environment; exposure; geosynthetic; long-term performance

TABLE 1 Functions[A] and Other Performance Characteristics[B]

Containment[B] (C)—A geosynthetic provides containment when it encapsulates or surrounds materials such as sand, rocks, and fresh concrete.[C]
Filtration[A] (F)—A geosynthetic performs the filtration function when the equilibrium geotextile-to-soil system allows for adequate liquid flow with limited soil loss across the plane of the geotextile over a service lifetime compatible with the application under consideration.
Fluid Barrier[A] (FB)—A geosynthetic performs the fluid barrier function when it essentially eliminates the migration of fluids through it.
Fluid Transmission[A] (*a.k.a. drainage*)—A geosynthetic performs the fluid transmission function when the equilibrium geotextile-to-soil system allows for adequate flow with limited soil loss within the plane of the geotextile over a service lifetime compatible with the application under consideration.
Insulation[B] (I)—A geosynthetic provides insulation when it reduces the passage of heat, electricity, or sound.
Protection[A] (P)—A geosynthetic, placed between two materials, performs the protection function when it alleviates or distributes stresses and strains transmitted to the material to be protected.
Reinforcement[A] (R)—A geosynthetic performs the reinforcement function when it provides often synergistic improvement of a total system's strength created by the introduction of a tensile force into a soil (good in compression but poor in tension) or other disjointed and separated material.
Screening[B] (Scr)—A geosynthetic, placed across the path of a flowing fluid (ground water, surface water, wind) carrying particles in suspension, provides screening when it retains some or all soil fine particles while allowing the fluid to pass through. After some period of time, particles accumulate against the screen which requires that the screen be able to withstand pressures generated by the accumulated particles and the increasing fluid pressure.
Separation[A] (S)—A geosynthetic placed between dissimilar materials so that the integrity and functioning of both materials can remain intact or be improved performs the separation function.
Surface Stabilization[B] (SS)—A geosynthetic, placed on a soil surface, provides surface stabilization when it restricts movement and prevents dispersion of surface soil particles subjected to erosion actions (rain, wind), often while allowing or promoting vegetative growth.
Vegetative Reinforcement[B] (VR)—A geosynthetic provides vegetative reinforcement when it extends the erosion control limits and performance of vegetation.

[A] Functions are used in the context of this guide as terms that can be quantitatively described by standard tests or design techniques, or both.
[B] Other performance characteristics are qualitative descriptions that are not yet supported by standard tests or generally accepted design techniques.
Note—during the placement of fresh concrete in a geotextile flexible form, the geosynthetic functions temporarily as a filter to allow excess water to escape.