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Standard Guide for the Selection of Test Methods for Flexible Polypropylene Geomembranes[1]

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1. Scope

1.1 This guide covers recommendations for the selection of appropriate test methods for flexible polypropylene sheet used in geomembrane applications to provide consistency in data reporting.

1.2 This guide includes test methods for three types of flexible polypropylene geomembranes including smooth nonreinforced sheet, textured nonreinforced sheet, and scrim-reinforced sheet.

1.3 This guide is intended to aid all personnel involved in the selection, manufacture, installation, or evaluation of flexible polypropylene geomembrane sheet.

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:*[2]

D471 Test Method for Rubber Property—Effect of Liquids
D573 Test Method for Rubber—Deterioration in an Air Oven
D618 Practice for Conditioning Plastics for Testing
D696 Test Method for Coefficient of Linear Thermal Expansion of Plastics Between −30°C and 30°C with a Vitreous Silica Dilatometer
D746 Test Method for Brittleness Temperature of Plastics and Elastomers by Impact
D751 Test Methods for Coated Fabrics
D790 Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
D792 Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement
D1004 Test Method for Tear Resistance (Graves Tear) of Plastic Film and Sheeting
D1149 Test Methods for Rubber Deterioration—Cracking in an Ozone Controlled Environment
D1204 Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature
D1238 Test Method for Melt Flow Rates of Thermoplastics by Extrusion Plastometer
D1505 Test Method for Density of Plastics by the Density-Gradient Technique
D1603 Test Method for Carbon Black Content in Olefin Plastics
D2136 Test Method for Coated Fabrics—Low-Temperature Bend Test
D2137 Test Methods for Rubber Property—Brittleness Point of Flexible Polymers and Coated Fabrics
D3389 Test Method for Coated Fabrics Abrasion Resistance (Rotary Platform Abrader)
D3418 Test Method for Transition Temperatures and Enthalpies of Fusion and Crystallization of Polymers by Differential Scanning Calorimetry
D4218 Test Method for Determination of Carbon Black Content in Polyethylene Compounds By the Muffle-Furnace Technique
D4364 Practice for Performing Outdoor Accelerated Weathering Tests of Plastics Using Concentrated Sunlight
D4439 Terminology for Geosynthetics
D4833 Test Method for Index Puncture Resistance of Geomembranes and Related Products
D5199 Test Method for Measuring the Nominal Thickness of Geosynthetics
D5321 Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
D5323 Practice for Determination of 2a??% Secant Modulus for Polyethylene Geomembranes
D5397 Test Method for Evaluation of Stress Crack Resistance of Polyolefin Geomembranes Using Notched Constant Tensile Load Test

[1] This guide is under the jurisdiction of ASTM Committee D35 on Geosynthetics and is the direct responsibility of Subcommittee D35.10 on Geomembranes.

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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.

D5514 Test Method for Large Scale Hydrostatic Puncture Testing of Geosynthetics
D5617 Test Method for Multi-Axial Tension Test for Geosynthetics
D5721 Practice for Air-Oven Aging of Polyolefin Geomembranes
D5747 Practice for Tests to Evaluate the Chemical Resistance of Geomembranes to Liquids
D5884 Test Method for Determining Tearing Strength of Internally Reinforced Geomembranes
D5994 Test Method for Measuring Core Thickness of Textured Geomembranes
D6636 Test Method for Determination of Ply Adhesion Strength of Reinforced Geomembranes
D6693 Test Method for Determining Tensile Properties of Nonreinforced Polyethylene and Nonreinforced Flexible Polypropylene Geomembranes
D7003 Test Method for Strip Tensile Properties of Reinforced Geomembranes
D7004 Test Method for Grab Tensile Properties of Reinforced Geomembranes
D7613 Specification for Flexible Polypropylene Reinforced (fPP-R) and Nonreinforced (fPP) Geomembranes
E96/E96M Test Methods for Water Vapor Transmission of Materials
F1249 Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor
G151 Practice for Exposing Nonmetallic Materials in Accelerated Test Devices that Use Laboratory Light Sources
G154 Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials
G155 Practice for Operating Xenon Arc Light Apparatus for Exposure of Non-Metallic Materials

3. Terminology

3.1 *Definitions*—For definitions of geosynthetics terms used in this guide, refer to Terminology D4439.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *flexible polypropylene, n*—a material having a 2 % secant modulus of less than 300 MPa (42 850 psi) as determined by Practice D5323 produced by polymerization of propylene with or without other alpha olefin monomers.

4. Significance and Use

4.1 To evaluate flexible polypropylene properly, tests must be performed according to specific test methods and procedures. Failure to follow this guide can result in data not representative of the material's characteristics and performance.

5. Test Methods

5.1 Recommended test methods for flexible polypropylene sheet are listed in tables as follows:

5.1.1 Table 1—Flexible Polypropylene (fPP) Sheet Manufacturing Quality Control Tests;

5.1.2 Table 2—Optional Performance Tests for Flexible Polypropylene (fPP) Sheet; and,

6. Keywords

6.1 flexible polypropylene; geomembrane

TABLE 1 Flexible Polypropylene (fPP) Sheet Manufacturing Quality Control Tests

Sheet Type	Smooth Reinforced Sheet	Smooth Nonreinforced Sheet	Textured Nonreinforced Sheet	Textured Reinforced Sheet	Conditions
General:					
Terminology	D4439	D4439	D4439	D4439	
Conditioning	D618	D618	D618	D618	
Physical Properties:					
Thickness	D5199	D5199	D5994	D5994	
Ultimate tensile strength and elongation	D7004	D6693	D6693	D7004	Type IV, no extensometer grip separation = 63.5 mm (2.50 in.), strain rate = 509 mm/min (20 in./min)
Tear resistance	D5884	D1004	D1004	D5884	
Puncture resistance	D4833	D4833	D4833	D4833	
Ply adhesion	D6636	—	—	D6636	

TABLE 2 Optional Performance Tests for Flexible Polypropylene (fPP) Sheet

Sheet Type	Reinforced Sheet	Smooth Nonreinforced Sheet	Textured Sheet	Conditions
General:				
Terminology	D4439	D4439	D4439	
Conditioning	D618	D618	D618	
Physical Properties:				
Flow rates of thermoplastics		D1238	D1238	230°C, 2.16 kg
Carbon black content	D1603	D1603	D1603	
	D4218	D4218	D4218	
Low temperature bend	D2136	D2136	D2136	
Thermal expansion	D696	D696	D696	
Density	D1505	D1505	D1505	
	D792	D792	D792	
Water vapor transmission	E96/E96M	E96/E96M	E96/E96M	
	F1249	F1249	F1249	
Water absorption	D471	D471	D471	
Mechanical Properties:				
2 % Secant modulus	D5323	D5323	D5323	
Flexural modulus	D790	D790	D790	
Hydrostatic resistance	D5514	D5514	D5514	
	D751A, Procedure 1			
Multi-axial tensile	D5617	D5617	D5617	
Geosynthetic friction by direct shear	D5321	D5321	D5321	
Thermal Properties:				
Dimensional stability	D1204	D1204	D1204	100°C, 1 h
Melting temperature	D3418	D3418	D3418	
Brittleness point	D2137	D2137	D2137	
	D746	D746	D746	
Endurance Properties:				
Weathering Resistance	D7613	D7613	D7613	
	G151	G151	G151	
	G154	G154	G154	
	G155	G155	G155	
	D4364	D4364	D4364	
				Cycle 1
Ozone resistance	D1149	D1149	D1149	
Stress crack resistance	D5397	D5397	D5397	
Oven aging	D573	D573	D573	85°C
	D5721	D5721	D5721	
Abrasion resistance	D3389	D3389	D3389	
Chemical resistance	D471	D471	D471	
	D5747	D5747	D5747	