

POLYMERIC GEOMEMBRANES

PHYSICAL PROPERTIES

Asperity Height	ASTM D7466, GRI GM12
Density	ASTM D792
Thickness (PVC)	ASTM D1593
Thickness (Smooth PE)	ASTM D751, D5199, ISO9863-1
Thickness (Textured PE)	ASTM D5994
Weight	ASTM D751, ISO 9864

COMPOSITION / GENERAL PROPERTIES

Brittleness Temperature	ASTM D746
Carbon Black Content	ASTM D1603, D4218
Carbon Black Dispersion	ASTM D5596, D3015, ISO 18553
Coefficient of Thermal Expansion	ASTM D696
Dimensional Stability	ASTM D1204
Extractable Content	EPA 600/2-88/052-App.E
Extraction	ASTM D3421
Hardness	ASTM D2240
Melt Index	ASTM D1238, ISO 1133
Microscopic Analysis	--
OIT	ASTM D3895, EN728
HP-OIT	ASTM D5885
PVC Plasticizers (Content, Molecular Weight)	ASTM D2124
Volatile Loss	ASTM D1203
Water Extraction	ASTM D1239, D3083

BARRIER PROPERTIES

Water Vapor Transmission Rate	ASTM F1249, E96 (B, BW)
Water permeability	EN 14150
Gas permeability	ASTM D1434, ISO 15105
Oxygen Transmission Rate	ASTM D3985

MECHANICAL PROPERTIES

2% Secant Modulus	ASTM D5323
Adhesion of Coating	ASTM D751, D903
Flexural Strength (2 directions)	ASTM D790
Grab Tensile (Reinforced Geomembranes)	ASTM D751, D7004
Hydrostatic Resistance	ASTM D751A
Impact	ASTM D746
Puncture	ASTM D4833, FTMS101C/2065
Puncture, pyrazimidal	EN 14574
Geomembrane Seams (PE)	ASTM D6392, D4437, D6214, ASTM D3083, D4545
Geomembrane Seams (Tape)	ASTM D7272
Geomembrane Seams (PVC)	D882 mod., D7408
Geomembrane Seams (Reinforced)	ASTM D751, D7747 (Strip) D7749 (Grab)
Tear (unreinforced)	ASTM D1004
Tear (Reinforced Geomembranes)	ASTM D751, D5884
Tensile (Multiaxial)	ASTM D5617, ISO 14151
Tensile (PE)	ASTM D6693, ISO 527
Tensile (PVC)	ASTM D882

Tensile (Reinf. Geomembranes)	ASTM D751, D7003 (Strip), D7004 (Grab)
Tensile (Wide Width - 10 % / min)	ASTM D4885
Tensile With Extensometer	ASTM D638

PERFORMANCE & DURABILITY

Guidelines for the assessment of durability	ASTM D5819, ISO 13434, EN 12226
Chemical Compatibility	ASTM D5747, D5322, EPA 9090
Chemical resistance for landfill applications	EN 14414
Hydrostatic Puncture / Truncated Cones	ASTM D5514
Interface Shear Strength	ASTM D5321, ISO 12957-1
Low Temperature Bend Test	ASTM D2136
Resistance to oxidation	ISO 13438, EN 14575
Resistance to leaching	EN 14415
Oven Aging	ASTM D5721
Microbiological Resistance / Soil Burial	ASTM G160, D3083, EN 12225
Stress Cracking Resistance	ASTM D5397, EN 14576
UV (Fluorescent)	ASTM D7238, G154, GRI GM11, EN 12224
UV (Xenon)	ASTM D4355, G155, ISO 4892

MATERIAL SPECIFICATIONS AND TEST SELECTION GUIDES

Guide for Selection of Rate of Fluid Permeation Through Geomembranes	D5886
Guide for Flexible Polypropylene Geomembranes	D6434
Guide for Mechanical Attachment to Penetrations or Structures	D6497
Guide for EPDM Geomembranes	D7106
Specification for PVC Geomembranes	D7176
Specification for EPDM Geomembrane	D7465
Specification for fPP-R and fPP Geomembranes	D7613
Guide for Selecting Test Methods for Geomembrane Seams	D7700
Practice for Electrical Leak Location - Water Lance System	D7703
Characteristics / construction of reservoirs and dams	EN 13361
Characteristics / construction of canals	EN 13362
Characteristics / tunnels and underground structures	EN 13491
Characteristics / liquid waste disposal sites or transfer sites	EN 13492
Characteristics / solid waste storage and disposal sites	EN 13493
Characteristics / transportation infrastructures	EN 15382

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GEOSYNTHETIC CLAY LINERS (GCL)

PHYSICAL PROPERTIES

Thickness	ASTM D5199, ISO 9863-1
Weight, Water Content, Bentonite Content	ASTM D5993, ISO 9864
Weight (Geotextiles)	ASTM D5261

PROPERTIES OF THE MINERAL FRACTION

Swell Index	ASTM D5890
Fluid Loss	ASTM D5891
Water absorption of bentonite	ISO 10769

MECHANICAL PROPERTIES

GCL Tensile	ASTM D6768, D4632
Wide Width Tensile properties	ASTM D4595, ISO 10319
Peel Strength	ASTM D6496, ASTM, D4632 mod.
Puncture (50mm Probe)	ASTM D6241, ISO 12236
Tensile Strength (Grab)	ASTM D4632
Hydraulic Properties	
Hydraulic Conductivity (Water)	ASTM D5887, ASTM, D5084
Clay geosynthetic barriers -- Permeability to gases	ISO 10773

PERFORMANCE & DURABILITY

Internal / Interface Shear Strength	ASTM D6243, ISO 12957-1
Large Scale Hydrostatic Puncture	ASTM D5514
Guidelines for the assessment of durability	ASTM D5819, ISO/TS 13434
Chemical Compatibility (Mineral Fraction)	ASTM D6141
Hydraulic Conductivity (With Contaminants)	ASTM D6766
Chemical Compatibility	SAGEOS GC001
Chemical resistance for landfill applications	EN 14414

MATERIAL SPECIFICATIONS AND TEST SELECTION GUIDES

Manufacturing Quality Control	ASTM D5889
Acceptance testing of GCL	ASTM D6495
Characteristics / construction of reservoirs and dams	EN 13361
Characteristics / construction of canals	EN 13362
Characteristics / tunnels and underground structures	EN 13491
Characteristics / liquid waste disposal sites or transfer sites	EN 13492
Characteristics / solid waste storage and disposal sites	EN 13493
Characteristics / transportation infrastructures	EN 15382

BITUMINOUS GEOMEMBRANES

PHYSICAL PROPERTIES

Density	ASTM D792
Mass per Unit Area	ASTM D5261, ASTM D3776, ISO 9864
Thickness	ASTM D5199, ASTM D5147, ISO 9863-1

MECHANICAL PROPERTIES

Wide Width Tensile	ASTM D4595, ISO 10319
Tensile	ASTM D7275, ISO 527, EN 12311-1, NF-P-84-501
Puncture Resistance	ASTM D4833, ASTM, D6241, ISO 12236
Seams Shear Resistance	ASTM D7056
Tear Resistance	ASTM D4073, ASTM D1970

GENERAL PROPERTIES

Coefficient of Thermal Expansion	ASTM D696
Low Temperature Flexibility	ASTM D1970
Thermal Stability	ASTM D1970
Water Absorption	ASTM D1970, ASTM D95

PERFORMANCE & DURABILITY

Guidelines for the assessment of durability	ASTM D5819, ISO 13434, EN 12226
Dimensional Stability	ASTM D1204
Hydrostatic Puncture / Truncated Cones	ASTM D5514
Interface Shear Strength	ASTM D5321, ISO 12957-1
Low Temperature Flexibility	ASTM D5147, ASTM, D1970
Chemical Compatibility	ASTM D5747, D5322, EPA 9090
Chemical resistance for landfill applications	EN 14414
Resistance to oxidation	ISO 13438, EN 14575
Resistance to leaching	EN 14415
Oven Aging	ASTM D5721
Microbiological Resistance / Soil Burial	ASTM G160, D3083, EN 12225
UV (Fluorescent)	ASTM D7238, G154, EN 12224
UV (Xenon)	ASTM D4798, G155, ISO 4892

BARRIER PROPERTIES

Water Vapor Transmission Rate	ASTM F1249, ASTM E96 (B, BW)
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MATERIAL SPECIFICATIONS AND TEST SELECTION GUIDES

Guide for Selection of Rate of Fluid Permeation Through Geomembranes	D5886
Guide for Prefabricated Bituminous Geomembranes (PBGm)	D6455
Specification for Bituminous Geomembrane (Canal and Ditch Liner)	D2643
Characteristics / construction of reservoirs and dams	EN 13361
Characteristics / construction of canals	EN 13362
Characteristics / tunnels and underground structures	EN 13491
Characteristics / liquid waste disposal sites or transfer sites	EN 13492
Characteristics / solid waste storage and disposal sites	EN 13493
Characteristics / transportation infrastructures	EN 15382

GEOTEXTILES

PHYSICAL PROPERTIES

Thickness	ASTM D5199, D1777, ISO 9863-1, CAN/CGSB 148.1-3
Thickness (Each Layer/Multilayered Products)	ISO 9863-2
Thickness Under Load	ISO 9863-1, EN 964-1
Weight	ASTM D5261, D3776, ISO 9864, EN 965, CAN/CGSB 148.1-2

FIBERS / MICROSCOPIC PROPERTIES

Carboxyl End Group	GRI GG7
Crimp	ASTM D3937
Fiber Analysis	ASTM D276, CAN/CGSB 14.1 to 14.18
Fiber Analysis (DSC)	ASTM E793, E794, D3417, D3418
Fiber Length	ASTM D5103
Fibers Breaking Strength	ASTM D3822
Microscopic Analysis (SEM, Optic)	--

MECHANICAL PROPERTIES

Abrasion	ASTM D4886, ISO 13427
Burst (Ball)	ASTM D3787, CAN/CGSB 4.2-11.2
Burst (Mullen)	ASTM D3786, CAN/CGSB 4.2-11.1
Hydrostatic Resistance	ASTM D751A, EN 13562
Puncture	ASTM D4833, FTMS 101C/2065
Puncture (50 mm Probe / 'CBR Test')	ASTM D6241, ISO 12236
Puncture (Dynamic / cone drop)	ISO 13433, EN 918
Pyramid Puncture	ASTM D5495, NF G38- 019
Sewn Seam Strength	ASTM D4884, ISO 10321

Stiffness	ASTM D1388, D5732, CAN/CGSB 148.1-14
Tear	ASTM D4533, D1117, CAN/CGSB 4.2-12.2
Tensile (Grab)	ASTM D4632, D5034, CAN/CGSB 148.1-7.3
Tensile (Strip)	ASTM D5035
Wide Width Tensile	ASTM D4595, ISO 10319

HYDRAULIC PROPERTIES

Opening Size (AOS)	ASTM D4751
Opening Size (Bubble Point)	ASTM F316, SAGEOS GX005
Opening Size (FOS)	NFG 38017, CAN/CGSB 148.1-10
Opening Size (Wet Sieving)	ISO 12956
Number of Constrictions	ASTM D7178
Percent Open Area (POA)	COE CW 22125
Permeability	ASTM D4491, ISO 11058, NFG 38016, CAN/CGSB 148.1-4
Permittivity Under Load	ASTM D5493, ISO 10776
Resistance to Water Penetration	ISO 811, CAN/CGSB 4.2-26.3
Transmissivity (Radial)	ASTM D6574
Transmissivity	ISO 12958
Water Retention Capacity	SAGEOS GX010
Behavior / Water Supply by Capillarity	SAGEOS GX011
Capillarity	SAGEOS GX012
Water Front Speed (Capillary Mats)	SAGEOS GX013

PERFORMANCE & DURABILITY

Guidelines for the assessment of durability	ASTM D5819, ISO 13434, EN 12226
Asphalt Retention	ASTM D6140
Biological Clogging Resistance	ASTM D1987
Chemical Compatibility	ASTM D6389, D5322, ISO 12960
Chemical resistance for landfill applications	EN 14414
Gradient Ratio	ASTM D5101, SAGEOS, GX006
Hydraulic Conductivity Ratio (Filtration)	ASTM D5567
Hydrostatic Puncture (Large Scale)	ASTM D5514
Installation Damage	ASTM D5818, ISO 10722
Interface Shear Strength	ASTM D5321, ISO 12957-1
Resistance to oxidation	ISO 13438, EN 14575
Outdoor Exposure	ASTM D5970
Silt Fence Efficiency	ASTM D5141
Flow Rate of Water and Suspended Solids from a Geotextile Bag	ASTM D7701
UV (Fluorescent)	ASTM G154, EN 12224
UV (Xenon)	ASTM D4355, G155, ISO 4892

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MATERIAL SPECIFICATIONS AND TEST SELECTION GUIDES

Specification for Circular-Knit Geotextile	ASTM D6707
Hybrid Geosynthetic Paving Mat Specification	ASTM D7239
Characteristics required for use in earthworks, foundations and retaining structures	EN13251
Resistance to acid and alkaline liquids	ISO 12960, EN14030
Characteristics required for use in liquid waste containment projects	EN 13265
Chemical resistance for landfill applications	EN 14414

GEONETS AND DRAINAGE PRODUCTS

PHYSICAL PROPERTIES

Carbon Black Content	ASTM D1603, ASTM, D4218
Density	ASTM D792
Melt Index	ASTM D1238
Thickness	ASTM D5199, D1777, ISO 9863-1
Thickness / Individual layers of multilayered products	ISO 9863-2
Mass per unit area	ASTM D5261, D3776, ISO 9864

MECHANICAL PROPERTIES

Compression	ASTM D6364, D1621, ISO 25619-2
Peel Strength	ASTM D7005, F904, D413, ISO 13426-2
Tensile	ASTM D7179, D5035
WW Tensile	ASTM D4595, ISO 10319
Vertical Compression of Geocomposite Pavement Panel Drains	ASTM D6244
Static puncture test (CBR test)	ISO 12236

HYDRAULIC PROPERTIES

Transmissivity	ASTM D4716, ISO 12958
Vertical Strip Drains in the Crimped Condition	ASTM D6918

PERFORMANCE & DURABILITY

Guidelines for the assessment of durability	ASTM D5819, ISO 13434, EN 12226
Accelerated compressive creep properties	ISO 25619-1, ASTM D7361
Chemical Compatibility	ASTM D6388, D5322, ISO/TR 12960
Chemical resistance for landfill applications	EN 14414
Interface Shear Strength	ASTM D5321, ISO 12957-1 (direct shear), 12957-2 (inclined plane)
Resistance to oxidation	ISO 13438
UV (Fluorescent)	ASTM G154, EN 12224
UV (Xenon)	ASTM D4355, G155, ISO 4892
Vertical Strip Drains testing / Large Scale Consolidation Test	ASTM D7498
Soil burial	ISO 13437
Resistance to oxidation	ISO 13438

MATERIAL SPECIFICATIONS AND TEST SELECTION GUIDES

Prefabricated Vertical Drains (PVD) Guide	ASTM D6917
Edge Drains Specification	ASTM D7001
Acceptance Testing of Geonets and Drainage Geocomposites	ASTM D7273
Design guidances for PVDs	EN-15237

GEOGRIDS

PHYSICAL PROPERTIES

Dimensions	--
Thickness	ASTM D5947, D5199, D1777, ISO 9863-1
Mass per unit area	ASTM D5261, ISO 9864

MECHANICAL PROPERTIES

Wide Width Tensile Properties	ASTM D4595, D6637(B), ISO 10319
Tensile Strength (Single Rib)	ASTM D6637(A), GRI GG1
Junction Strength	ASTM D7737, GRI GG2
Flexural Stiffness	ASTM D1388, D5732
Flexural Rigidity	ASTM D7748
Torsional Stiffness / Aperture Stability	ASTM WK24635 (draft)

Performance & Durability

Carboxyl End Group	GRI GG7, ASTM D7409
Chemical Compatibility	ASTM D5322, D6213, ISO/TR 12960
Chemical resistance for landfill applications	EN 14414
Soil burial	ISO 13437
Resistance to oxidation	ISO 13438
Resistance to hydrolysis	EN 12447
Concrete Blocks Shear Strength	ASTM D6916
Connection Strength	ASTM D6638
Creep Properties	ASTM D5262, ISO 13431
Accelerated Creep	ASTM D6992
Installation Damage	ASTM D5818, ISO 13437
Installation Damage (index)	ISO 10722
Interface Shear Strength	ASTM D5321, ISO 12957-1
Intrinsic Viscosity / Molecular Weight (PET)	ASTM D4603
Pull-Out Resistance	ASTM D6706, GRI GG5
Small-Strain Tensile Properties / In-Air Cyclic Tension Tests	ASTM D7556
UV (Xenon)	ASTM D4355, G155, ISO 4892

Design Guidances

Guidelines for the assessment of durability	ASTM D5819, ISO/TS 13434
Long-term strength of geosynthetics for soil reinforcement	ISO/TR 20432

EROSION CONTROL PRODUCTS

PHYSICAL PROPERTIES

Absorbency	ASTM D1117
Light Penetration	ASTM D6567
Mass	ASTM D6475, D6566
Resiliency	ASTM D6524
Stiffness	ASTM D6575
Thickness	ASTM D6525

MECHANICAL PROPERTIES

Compression	ASTM D6454
Tensile	ASTM D6818

SYNTHETIC TURFS, SPORT SURFACES

PHYSICAL PROPERTIES

Abrasiveness	ASTM F1015
Apparent Density	ASTM D1895 (B)
Component Masses	ASTM D418, D5848
Linear Density	ASTM D1577
Number of Binding Sites	ASTM D418, D5793
Pile Thickness	ASTM D418
Pile Yarn Mass	ASTM D418, D5848
Total Mass	ASTM D418, D5848
Tuft Height	ASTM D418, D5823

MECHANICAL PROPERTIES

Compression Set	ASTM D1667 (suffix B)
Seam Resistance	ASTM D4884, EN 12228
Tear Resistance	ASTM D624
Tensile (Elastomeric Material)	NF EN 12230
Tensile (Grab)	ASTM D1682, D5034
Tensile (Tuft / Yarn)	ASTM D2256, ISO 4919
Tuft Bind Resistance	ASTM D1335

HYDRAULIC PROPERTIES

Water Permeability	ASTM D4491, F1551, DIN 18-035
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THERMAL PROPERTIES

DSC Analysis	ASTM E794
Melting point	ASTM D789

Fire Resistance Properties

Flammability Tests	ASTM D2859, E648, D4804
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RESEARCH AND FORENSIC ANALYSIS

FINGERPRINTING EQUIPMENTS (SELECTED)

- DSC Differential Scanning Calorimetry, with Cooling Unit
- TGA Thermogravimetric Analysis
- HPLC/GC-MS (High Performance Liquid Chromatography / Gas Chromatography, Coupled with a Mass Spectrometer)
- FTIR-ATR Infrared Spectrophotometer – with Attenuated Total

REFLECTANCE

- Spectrophotometer UV – Near Infrared
- Ionic Chromatograph
- ICP (Inductive Coupled Plasma)
- Thermal Conductivity Analyser
- Electronic Microscopy (partnership)

PERFORMANCE TESTING

- Dynamometer with Environmental Chamber (-70°C to +250°C)
- Several Impact Resistance Tests (Izod, Gardner, Dart...)
- Thermal Infrared Camera

FIRE RESISTANCE LABORATORY

Fire Resistance Evaluations: Accredited by Transport Canada

- Radiant Panel (ASTM E162)
- Vertical Flame Test (Federal Aviation Regulation)
- Smoke Density (ASTM E662)
- Flooring Radiant Panel Test (ASTM E648)
- Several other index test (Flame Spread etc.)

MANUFACTURING AND SMALL SCALE PRODUCTION UNITS

- Non-Woven (Needle-Punched) with several finishing options
- 3D Weaving
- Plasma Treatment
- Narrow Weaving Machine equipped with Jacquard Head
- Flat Knitting Machine
- E-embroidery Machine
- Warp Knitting Machine

SAGEOS is a division of the CTT Group, a non-for-profit technology transfer center specialized in technical textiles, geosynthetics and flexible advanced materials.

The CTT Group employs 60 professionals. Ph.D. and M Sc. A. scientists and researchers specializing in Chemistry, Civil Engineering / Geotechnical, Materials / Physics, Mechanical / Composites, Plastics / Polymers, Textiles .

Engineers with backgrounds in: Textiles, Mechanical, Electrical, Civil, Geotechnical, Electronic, Plastics (polymers), Microbiology.

Technicians holding technical degrees in civil, textile, plastic, pharmaceutical and other related fields.

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