



GEOMEMBRANES

PRODUCT DATA

FOR MORE INFORMATION

The specification charts have been provided for comparative purposes only. Designers should contact manufacturers for additional details and to discuss site-specific considerations.

Information on the use and specification of geomembranes is also available from the Geosynthetic Materials Association (GMA).

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PUBLISHER'S NOTE

All information included in this Specifier's Guide was compiled from information submitted by firms in the geosynthetics industry. Specifications were submitted voluntarily and their accuracy is the responsibility of the manufacturer. The appearance of a listing in this directory is not an endorsement of the company or product by *Geosynthetics* magazine or the Industrial Fabrics Association International (IFAI). The Specifier's Guide is intended as a guide, and *Geosynthetics* and IFAI encourage readers to contact the companies listed for further information.

These products are engineered to help provide cost-effective solutions and to meet specific design requirements in fluid barrier, containment, and other geotechnical applications.

Geomembranes have been used since the 1950s and their use has steadily increased as a result of water resource concerns. It is now common to find local and state regulations calling for infrastructure designs that use geomembranes for containment, lining, and capping. Whether for potable water or animal waste, these materials have become central to project acceptance and success.

Geomembranes are available in a variety of physical, mechanical, and chemical resistance properties designed to meet the requirements of a wide range of applications. For example, the products can be compounded for exposure to ultraviolet light, ozone, and microorganisms in soil. Different combinations of these properties exist in various geosynthetic lining materials to cover a wide spectrum of geotechnical applications and designs.

Several methods are used to join the geosynthetic lining materials in the factory and in the field. Each material has highly developed quality-control techniques that govern its manufacture and installation.

The numbers

Companies that submitted product data chart lines were asked to provide data determined through industry-accepted testing methods. Companies signed a certificate of compliance verifying the accuracy of this data.

| Product Name | Base Polymer [1] | Dimensional Properties | | | Density ASTM D1505 (g/cm ³)s | Tensile Properties ASTM D6693 | | | Puncture Resistance ASTM D4833 kN (lb) | Tear Resistance ASTM D1004 kN (lb) | Low Temperature Brittleness ASTM D746 °C (°F) [3] | Carbon Black Content ASTM D1603 (%) | Carbon Black Dispersion ASTM D5596 [4] | Manufacturer's Suggested Applications [5] |
|--|----------------------------|--------------------------|---|------------------------------------|--|-------------------------------|-----------------------------|--------------------------|--|------------------------------------|---|-------------------------------------|--|---|
| | | Roll Width/Length m (ft) | [2] Thickness ASTM 5199 mm (mils) | [2] Thickness ASTM D5994 mm (mils) | | Strength Yield kN/m (lb/in) | Strength Break kN/m (lb/in) | Elongation Yield/Break % | | | | | | |
| AgruAmerica Inc. www.agruamerica.com | | | | | | | | | | | | | | |
| Agru Drain Liner | LLDPE Structured | 7.0/91.434 (23/300') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Note [4] | CL, SIL, LL, LC, LPL, DL |
| Agru Grip Liner | LLDPE Structured | 7.0/91.434 (23/300') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Note [4] | CL, SIL, LL, LC, LPL, DL |
| Agru Microspike Liner | LLDPE-T | 7.0/283.47 (23/710') | NA | 1.0 (40) | 0.939 max. | NA | 20 (112) | NA/400 | 0.22 (50) | 0.11 (25) | -60 (-83) | 2-3 | Note [4] | CL, LC, TL, LPL, DL |
| Agru Microspike Liner | LLDPE-T | 7.0/216.41 (23/505') | NA | 1.5 (60) | 0.939 max. | NA | 29 (168) | NA/400 | 0.31 (70) | 0.16 (36) | -60 (-83) | 2-3 | Note [4] | CL, LC, TL, LPL, DL |
| Agru Microspike Liner | LLDPE-T | 7.0/117.35 (23/385') | NA | 2.0 (80) | 0.939 max. | NA | 39 (224) | NA/400 | 0.40 (90) | 0.22 (50) | -60 (-83) | 2-3 | Note [4] | CL, LC, TL, LPL, DL |
| Agru Smooth Liner | LLDPE-S | 7.0/254.51 (23/835') | 1.0 (40) | NA | 0.939 max. | NA | 28 (160) | NA/800 | 0.27 (60) | 0.11 (25) | -60 (-83) | 2-3 | Note [4] | CL, LC, TL, LPL, DL |
| Agru Smooth Liner | LLDPE-S | 7.0/164.59 (23/540') | 1.5 (60) | NA | 0.939 max. | NA | 42 (240) | NA/800 | 0.40 (90) | 0.16 (37) | -60 (-83) | 2-3 | Note [4] | CL, LC, TL, LPL, DL |
| Agru Smooth Liner | LLDPE-S | 7.0/126.49 (23/415') | 2.0 (80) | NA | 0.939 max. | NA | 56 (320) | NA/800 | 0.53 (120) | 0.21 (48) | -60 (-83) | 2-3 | Note [4] | CL, LC, TL, LPL, DL |
| Agru Super Gripnet Liner | LLDPE Structured | 7.0/91.435 (23/300') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Note [4] | CL, SIL, LL, LC, LPL, DL |
| Agru ClosureTurf Liner/Turf | LLDPE O/C Structured -Turf | 7.0/91.435 (23/300') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Note [4] | CL, SIL, LL, LC, LPL, DL |
| Atarfil S.L. www.atarfil.com | | | | | | | | | | | | | | |
| ATARFIL LLDS Coextruded | LLDPE | 6.00/70-210 | 1.00-3.00 | NA | NP | NA | 26-78 | NA | 0.33-0.96 | 0.10-0.30 | -75 | 2-2,5 | 1-2 | CL, SIL, DP, RP |
| ATARFIL LTM LTMT * | LLDPE-TM-TMT | 6.00/70-211 | 1.00-3.01 | NA | NP | NA | 26-78 | NA | 0.33-0.96 | 0.10-0.30 | -75 | 2-2,5 | 1-2 | LC |
| ATARFLEX | Thermoplastic polyolefines | 2.00/70-210 | 0.75-2.00 | NA | NP | NA | 26-52 | NA | 0.25-0.75 | 0.09-0.26 | -70 | 2-2,5 | 1-2 | SIL, TL |
| ATARFLEX S Coextruded | Thermoplastic polyolefines | 2.00/25-30 | 0.75-2.00 | NA | NP | NA | 26-52 | NA | 0.25-0.75 | 0.10-0.30 | -70 | 2-2,5 | 1-2 | SIL, DP, TL |
| ATARFLEX TS Tunnel | Thermoplastic polyolefines | 2.00/25-30 | 1.50-3.00 | NA | NP | NA | 19-49 | NA | 0.25-0.75 | 0.10-0.30 | -70 | 2-2,5 | 1-2 | TL |
| ATARFLEX TW Tunnel | Thermoplastic polyolefines | 2.00/25-30 | 1.50-3.00 | NA | NP | NA | 19-49 | NA | 0.25-0.75 | 0.09-0.26 | -70 | NP | NP | TL |
| ATARFLEX W | Thermoplastic polyolefines | 2.00/25-30 | 0.75-2.00 | NA | NP | NA | 19-52 | NA | 0.25-0.75 | 0.09-0.26 | -70 | NP | NP | Tank lining |
| * Tensile, Puncture and Tear Properties: Values obtained from the smooth part of geomembrane | | | | | | | | | | | | | | |
| Engineered Polymer Technologies www.epttech.com | | | | | | | | | | | | | | |
| EPT Xtrm Ply Ftpu | TPU Ester or Ether | Width 60" to 120" | 20* to 120 mills *data listed is min. value for 20 mil Product. | NA | NA | NA | NA | NA | NA | 10* | -40 | NA | NA | SIL, SIC, SR, SC, LC, TL |

- [1] CX = Coextruded
 CX-T = Coextruded, textured
 EIA = Ethylene interpolmer alloy
 EPDM = Ethylene propylene diene monomer
 fPP = Flexible polypropylene
 LLDPE = Linear low density polyethylene
 LLDPE-T = Linear low density polyethylene, textured
 O/C = Other or combination
 TPO = Thermoplastic polyolefin
 T = Textured
 S = Smooth

- [2] ASTM D 5199: Nominal thickness of geosynthetics
 ASTM D 5994: Core thickness of textured geomembrane
 [3] No failures at this temperature.
 [4] Carbon black dispersion for 10 different views:
 • minimum of 9 of 10 in categories 1 or 2
 • all 10 in categories 1, 2, or 3

- [5] CL = Canal liner DL = Dam liner
 LPL = Leach pad liner SIC = Surface impoundment cover
 LC = Landfill cover LL = Landfill liner
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| Product Name | Base Polymer [1] | Dimensional Properties | | | Density ASTM D1505 (g/cm ³)s | Tensile Properties ASTM D6693 | | | Puncture Resistance ASTM D4833 kN (lb) | Tear Resistance ASTM D1004 kN (lb) | Low Temperature Brittleness ASTM D746 °C (°F) [3] | Carbon Black Content ASTM D1603 (%) | Carbon Black Dispersion ASTM D5596 [4] | Manufacturer's Suggested Applications [5] |
|--|------------------|--------------------------|-----------------------------------|------------------------------------|--|-------------------------------|-----------------------------|--------------------------|--|------------------------------------|---|-------------------------------------|--|---|
| | | Roll Width/Length m (ft) | [2] Thickness ASTM 5199 mm (mils) | [2] Thickness ASTM D5994 mm (mils) | | Strength Yield kN/m (lb/in) | Strength Break kN/m (lb/in) | Elongation Yield/Break % | | | | | | |
| GSE Lining Technology Inc. www.gseworld.com | | | | | | | | | | | | | | |
| GSE Ultraflex Smooth | LLDPE | 6.9/265 (22.5/870) | 1.0 (40) | NA | 0.939 | NA | 27 (152) | NA/800 | 0.250 (56) | 0.100 (22) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Smooth | LLDPE | 6.9/171 (22.5/560) | 1.5 (60) | NA | 0.939 | NA | 40 (228) | NA/800 | 0.370 (84) | 0.150 (33) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Smooth | LLDPE | 6.9/131 (22.5/430) | 2.0 (80) | NA | 0.939 | NA | 53 (304) | NA/800 | 0.500 (112) | 0.200 (44) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Textured | LLDPE-CX-T | 6.9/213 (22.5/700) | NA | 1.0 (40) | 0.939 | NA | 11 (60) | NA/250 | 0.200 (44) | 0.100 (22) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Textured | LLDPE-CX-T | 6.9/158 (22.5/520) | NA | 1.5 (60) | 0.939 | NA | 16 (90) | NA/250 | 0.300 (66) | 0.150 (33) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Textured | LLDPE-CX-T | 6.9/122 (22.5/400) | NA | 2.0 (80) | 0.939 | NA | 21 (120) | NA/250 | 0.400 (88) | 0.200 (44) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex White Smooth | LLDPE | 6.9/265 (22.5/870) | 1.0 (40) | NA | 0.939 | NA | 27 (152) | NA/800 | 0.250 (56) | 0.100 (22) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex White Smooth | LLDPE | 6.9/171 (22.5/560) | 1.5 (60) | NA | 0.939 | NA | 40 (228) | NA/800 | 0.370 (84) | 0.150 (33) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex White Smooth | LLDPE | 6.9/131 (22.5/430) | 2.0 (80) | NA | 0.939 | NA | 53 (304) | NA/800 | 0.500 (112) | 0.200 (44) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex White Textured | LLDPE-CX-T | 6.9/213 (22.5/700) | NA | 1.0 (40) | 0.939 | NA | 11 (60) | NA/250 | 0.200 (44) | 0.100 (22) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex White Textured | LLDPE-CX-T | 6.9/158 (22.5/520) | NA | 1.5 (60) | 0.939 | NA | 16 (90) | NA/250 | 0.300 (66) | 0.150 (33) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex White Textured | LLDPE-CX-T | 6.9/122 (22.5/400) | NA | 2.0 (80) | 0.939 | NA | 21 (120) | NA/250 | 0.400 (88) | 0.200 (44) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Smooth High Performance | LLDPE | 6.9/265 (22.5/870) | 1.0 (40) | | 0.939 | NA | 29 (170) | NA/900 | 0.311 (70) | 0.100 (22) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Smooth High Performance | LLDPE | 6.9/171 (22.5/560) | 1.5 (60) | | 0.939 | NA | 42 (240) | NA/900 | 0.444 (100) | 0.150 (33) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Smooth High Performance | LLDPE | 6.9/171 (22.5/560) | 2.0 (80) | | 0.939 | NA | 56 (320) | NA/900 | 0.578 (130) | 0.200 (44) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Textured High Performance | LLDPE-CX-T | 6.9/265 (22.5/870) | | 1.0 (40) | 0.939 | NA | 20 (115) | NA/500 | 0.289 (65) | 0.111 (25) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Textured High Performance | LLDPE-CX-T | 6.9/171 (22.5/560) | | 1.5 (60) | 0.939 | NA | 29 (168) | NA/500 | 0.422 (95) | 0.169 (38) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| GSE Ultraflex Textured High Performance | LLDPE-CX-T | 6.9/171 (22.5/560) | | 2.0 (80) | 0.939 | NA | 39 (224) | NA/500 | 0.556 (125) | 0.222 (50) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| Huikwang Corp. www.huitex.com | | | | | | | | | | | | | | |
| Huitex VF,VP | LLDPE CX | 7/84-420 (23/276-1378) | 0.50-2.50 (20-100) | NA | <0.939 | NA | 13-66 (76-380) | NA/800 | 0.12-0.62 (27-140) | 0.05-0.25 (11-56) | -70 (-94) | 2-3 | 1 or 2 | all |
| Huitex VX | LLDPE CX-T | 8/98-152 (26.2/250-500) | NA | 1.00-2.50 (40-100) | <0.939 | NA | 11-26 (60-150) | NA/250 | 0.20-0.50 (44-110) | 0.10-0.25 (22-55) | -70 (-94) | 2-3 | 1 or 2 | all |

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 CX-T = Coextruded, textured
 EIA = Ethylene interpolmer alloy
 EPDM = Ethylene propylene diene monomer
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 LLDPE = Linear low density polyethylene
 LLDPE-T = Linear low density polyethylene, textured
 O/C = Other or combination
 TPO = Thermoplastic polyolefin
 T = Textured
 S = Smooth

- [2] ASTM D 5199: Nominal thickness of geosynthetics
 ASTM D 5994: Core thickness of textured geomembrane
 [3] No failures at this temperature.
 [4] Carbon black dispersion for 10 different views:
 • minimum of 9 of 10 in categories 1 or 2
 • all 10 in categories 1, 2, or 3

- [5] CL = Canal liner
 LPL = Leach pad liner
 LC = Landfill cover
 TL = Tunnel liner
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 DL = Dam liner
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| Product Name | Base Polymer [1] | Dimensional Properties | | | Density ASTM D1505 (g/cm ³)s | Tensile Properties ASTM D6693 | | | Puncture Resistance ASTM D4833 kN (lb) | Tear Resistance ASTM D1004 kN (lb) | Low Temperature Brittleness ASTM D746 °C (°F) [3] | Carbon Black Content ASTM D1603 (%) | Carbon Black Dispersion ASTM D5596 [4] | Manufacturer's Suggested Applications [5] |
|--------------|------------------|--------------------------|-----------------------------------|------------------------------------|--|-------------------------------|-----------------------------|--------------------------|--|------------------------------------|---|-------------------------------------|--|---|
| | | Roll Width/Length m (ft) | [2] Thickness ASTM 5199 mm (mils) | [2] Thickness ASTM D5994 mm (mils) | | Strength Yield kN/m (lb/in) | Strength Break kN/m (lb/in) | Elongation Yield/Break % | | | | | | |

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| | | | | | | | | | | | | | | |
|----------------|---------|---------------------------|-----------|-----|------|-----|----------|-----|----------|---------|-----------|---|------------|---------------------|
| Herculine LD12 | LLDPE-S | 5.95 (19.5) / 521 (1,710) | 0.30 (12) | N/A | 0.92 | N/A | 7 (43) | 800 | 70 (16) | 26 (6) | -70 (-94) | 2 | Y, 1, 2, 3 | CL, LC, RP, SIC, DP |
| Herculine LD20 | LLDPE-S | 5.79 (19) / 341 (1,120) | 0.50 (20) | N/A | 0.92 | N/A | 13 (76) | 800 | 124 (28) | 47 (10) | -70 (-94) | 2 | Y, 1, 2, 3 | All |
| Herculine LD30 | LLDPE-S | 5.64 (18.5) / 226 (740) | 0.75 (30) | N/A | 0.92 | N/A | 20 (114) | 800 | 190 (42) | 71 (16) | -70 (-94) | 2 | Y, 1, 2, 3 | All |
| Herculine LD40 | LLDPE-S | 5.49 (18) / 170 (556) | 1.00 (40) | N/A | 0.92 | N/A | 27 (152) | 800 | 250 (56) | 98 (22) | -70 (-94) | 2 | Y, 1, 2, 3 | All |

Layfield Geosynthetics & Industrial Fabric Ltd. | www.layfieldgroup.com

| | | | | | | | | | | | | | | |
|---------------------|-------|----------------------|-----------|----|-------|----|------------|-------|------------|--------------|-----|-----|------|-------------------|
| Enviro Liner 3030 | LLDPE | 3.75/381 (12.3/1250) | 0.68 (27) | NA | 0.939 | NA | 20 (114) | 800% | 0.186 (42) | 0.071 (16) | -70 | 2-3 | Pass | CL, LPL, SIC, RP, |
| Enviro Liner 3040 | LLDPE | 3.75/305 (12.3/1000) | 0.91 (36) | NA | 0.939 | NA | 26.6 (152) | 800% | 0.250 (56) | 0.098 (22) | -70 | 2-3 | Pass | CL, LPL, SIC, LC |
| Enviro Liner 4030 | LLDPE | 3.75/381 (12.3/1250) | 0.76 (30) | NA | 0.939 | NA | 20 (114) | 800% | 0.186 (42) | 0.071 (16) | -70 | 2-3 | Pass | CL, LPL, SIC, RP, |
| Enviro Liner 4040 | LLDPE | 3.75/305 (12.3/1000) | 1.0 (40) | NA | 0.939 | NA | 26.6 (152) | 800% | 0.250 (56) | 0.098 (22) | -70 | 2-3 | Pass | CL, LPL, SIC, LC |
| Enviro Liner 6020HD | O/C | 3.75/609 (12.3/2000) | 0.51 (20) | NA | NA | NA | 19 (107) | 1500% | 0.196 (44) | 0.049 (11) | -70 | 2-3 | Pass | CL, LPL, SIC, LC |
| Enviro Liner 6030HD | O/C | 3.75/457 (12.3/1250) | 0.76 (30) | NA | NA | NA | 25 (141) | 1200% | 0.236 (53) | 0.078 (17.5) | -70 | 2-3 | Pass | CL, LPL, SIC, RP, |
| Enviro Liner 6040HD | O/C | 3.75/305 (12.3/1000) | 1.0 (40) | NA | NA | NA | 33.5 (191) | 1200% | 0.311 (70) | 0.107 (24) | -70 | 2-3 | Pass | CL, LPL, SIC, RP, |
| HAZGARD 535 | O/C | 3.75/305 (12.3/1000) | 0.88 (35) | NA | NA | NA | 22.8 (130) | 1000% | 0.218 (49) | 0.084 (19) | -40 | 2-3 | Pass | CL, LPL, SIC, RP, |

Raven Industries Inc. | www.ravengeo.com

| | | | | | | | | | | | | | | |
|-------------|-------|--------------------------------|-----------|----|--------|----|----------|-----|-----------|-----------|-----------|---|----------|--|
| Rufco 2000B | LLDPE | 4600 (50,000 ft ²) | 0.50 (20) | NA | ≤0.939 | NA | 13 (76) | 800 | 0.13 (30) | 0.05 (11) | -70 (-94) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| Rufco 3000B | LLDPE | 3500 (35,000 ft ²) | 0.75 (30) | NA | ≤0.939 | NA | 20 (114) | 800 | 0.20 (45) | 0.07 (16) | -70 (-94) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| Rufco 4000B | LLDPE | 2300 (25,000 ft ²) | 1.00 (40) | NA | ≤0.939 | NA | 27 (152) | 800 | 0.27 (60) | 0.1 (22) | -70 (-94) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |

Solmax International Inc. | www.solmax.com

| | | | | | | | | | | | | | | |
|-------------|---------|-----------------------|----------|------------|--------|----|------------|---------|-----------|-----------|------------|-----|-----|----------------|
| Solmax 840 | LLDPE-S | 6.8/237.7 (22.3/780) | 1.0 (40) | NA | <0.939 | NA | 28 (160) | 800/800 | 276 (62) | 0.1 (22) | -75 (-103) | 2-3 | 1-2 | DL, LC, TL, DP |
| Solmax 860 | LLDPE-S | 6.8/158.5 (22.3/520) | 1.5 (60) | NA | <0.939 | NA | 40 (228) | 800/800 | 408 (92) | 0.15 (34) | -75 (-103) | 2-3 | 1-2 | DL, LC, TL, DP |
| Solmax 880 | LLDPE-S | 6.8/121.9 (22.3/400) | 2.0 (80) | NA | <0.939 | NA | 56 (320) | 800/800 | 547 (123) | 0.2 (45) | -75 (-103) | 2-3 | 1-2 | DL, LC, TL, DP |
| Solmax 840T | LLDPE-T | 6.8/237.7 (22.3/780) | NA | 0.95 (38) | <0.939 | NA | 17.5 (100) | 400/400 | 250 (56) | 0.11 (26) | -75 (-103) | 2-3 | 1-2 | DL, LC, TL, DP |
| Solmax 860T | LLDPE-T | 6.8/164.6 (22.3/540) | NA | 1.425 (57) | <0.939 | NA | 23 (132) | 400/400 | 373 (84) | 0.16 (36) | -75 (-103) | 2-3 | 1-2 | DL, LC, TL, DP |
| Solmax 880T | LLDPE-T | 6.71/121.9 (22.0/400) | NA | 1.9 (76) | <0.939 | NA | 30 (176) | 400/400 | 495 (112) | 0.22 (50) | -75 (-103) | 2-3 | 1-2 | DL, LC, TL, DP |

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| Product Name | Base Polymer [1] | Dimensional Properties | | Density ASTM D1505/D792 (min.) (g/cm ³ min.) | Tensile Properties ASTM D 6693 [3] | | | | Puncture Resistance D 4833 (min. avg.) kN (lb) | Tear Resistance ASTM D 1004 (min. avg.) kN (lb) | Carbon Black Content ASTM D 1603 range (%) [4] | Carbon Black Dispersion ASTM D 5596 [5] | Stress Crack Resistance ASTM D 5397 Appendix [6] | Oxidative Induction Time (OIT) (min. avg.) [7] | | Oven Aging at 85°C ASTM D 5721 [7], [8] | | UV Resistance GM 11 [9] | Manufacturer's Suggested Applications [11] |
|--------------|------------------|--------------------------|---|---|------------------------------------|---------------------------|--------------------|--------------------|--|---|--|---|--|--|-------------------------------|---|-------------------------------------|-------------------------|--|
| | | Roll Width/Length m (ft) | Thickness ASTM D5199 (smooth) ASTM D5994 (textured) min. avg. mm (mils) [2] | | Strength | | Elongation | | | | | | | Standard OIT ASTM D 3895 | High Pressure OIT ASTM D 5885 | ASTM D3895 % retained after 90 days | ASTM D5885 % retained after 90 days | | |
| | | | | | Yield Stress kN/m (lb/in) | Break Stress kN/m (lb/in) | Yield Elongation % | Break Elongation % | | | | | | | | | | | |

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|--------------------------|-----------------|----------------------|-----------|------|----------|----------|----|-----|------------|-----------|-----|----------|-----|-----|-----|----|----|----|---------------------------------------|
| Agru Drain Liner | HDPE Structured | 7.0/91.434 (23/300') | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 300 | 0.42 (95) | 0.18 (40) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, LL, LC, LPL, DL |
| Agru Grip Liner | HDPE Structured | 7.0/91.434 (23/300') | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 300 | 0.42 (95) | 0.18 (40) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, LL, LC, LPL, DL |
| Agru Smooth Liner | HDPE-S | 7/316.99 (23/835) | 1.0 (40) | 0.94 | 15 (88) | 15 (88) | 13 | 700 | 0.36 (80) | 0.13 (30) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Smooth Liner | HDPE-S | 7/164.59 (23/540) | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 700 | 0.53 (120) | 0.20 (45) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Smooth Liner | HDPE-S | 7.0/102.109 (23/415) | 2.0 (80) | 0.94 | 31 (176) | 31 (176) | 13 | 700 | 0.71 (160) | 0.27 (60) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Micro Spike Liner | HDPE-T | 7.0/253.47 (23/710') | 1.0 (40) | 0.94 | 15 (88) | 15 (88) | 13 | 350 | 0.40 (90) | 0.13 (30) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Micro Spike Liner | HDPE-T | 7.0/216.41 (23/505') | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 350 | 0.53 (120) | 0.20 (45) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Micro Spike Liner | HDPE-T | 7.0/117.35 (23/385') | 2.0 (80) | 0.94 | 31 (176) | 31 (176) | 13 | 350 | 0.67 (150) | 0.27 (60) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Super Gripnet Liner | HDPE Structured | 7.0/91.434 (23/300') | 1.50 (60) | 0.94 | 20 (114) | 23 (132) | 13 | 200 | 0.40 (90) | 0.18 (40) | 2-3 | Note [5] | 300 | 100 | 400 | 55 | 80 | 50 | CL, SIL, LL, LC, LPL, DL |

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|------------------------|------|-------------|-----------|---------|-------|-------|----|-------|-----------|-----------|-------|-----|------|-----|----|----|----|----|--------------------------|
| ATARFIL HD | HDPE | 11.6/70-210 | 1.00-3.00 | ≥ 0,942 | 17-50 | 26-87 | >9 | ≥ 700 | 0.32-0.96 | 0.12-0.38 | 2-2,5 | 1,2 | ≥400 | 100 | NP | 55 | NP | NP | CL, SIL, LL, CL, LPL, RP |
| ATARFIL HDS Coextruded | HDPE | 11.6/70-210 | 1.00-3.00 | ≥ 0,942 | 17-50 | 26-87 | >9 | ≥ 700 | 0.32-0.96 | 0.12-0.38 | 2-2,5 | 1,2 | ≥400 | 100 | NP | 55 | NP | NP | DP, DL, RP, CL, SIL |
| ATARFIL TM-TMT* | HDPE | 6/70-210 | 1.00-3.00 | ≥ 0,942 | 17-50 | 26-87 | >9 | ≥ 700 | 0.32-0.96 | 0.12-0.38 | 2-2,5 | 1,2 | ≥400 | 100 | NP | 55 | NP | NP | landfill cover |

* Tensile, Puncture and Tear Properties: Values obtained from the smooth part of geomembrane

- [1] HDPE = High density polyethylene T = Textured
CX = Coextruded S = Smooth
- [2] Lowest individual of 10 values
- [3] Machine direction (MD) and cross machine direction (XD) average values should be on the basis of 5 test specimens each direction
• Yield elongation calculated with a gage length of 33mm
• Break elongation calculated with a gage length of 50mm
- [4] Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

- [5] Carbon black dispersion for 10 different views:
• minimum 9 of 10 in Categories 1 or 2
• all 10 in Categories 1, 2, or 3
- [6] The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- [7] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- [8] It also is recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

- [9] The condition of the test should be 20 hr. UV cycle at 75 C followed by 4 hr. condensation at 60 C.
- [10] UV resistance is based on percent retained value regardless of the original HP-OIT value.
- [11] CL = Canal liner DL = Dam liner
SIL = Surface impoundment liner LPL = Leach pad liner
SIC = Surface impoundment cover LCL = Landfill cover
LL = Landfill liner TL = Tunnel liner
DP = Decorative pond RP = Reserve pit
NP = Not provided by manufacturer
NA = Not applicable, per manufacturer

| Product Name | Base Polymer [1] | Dimensional Properties | | Density ASTM D1505/D792 (min.) (g/cm ³ min.) | Tensile Properties ASTM D 6693 [3] | | | | Puncture Resistance D 4833 (min. avg.) kN (lb) | Tear Resistance ASTM D 1004 (min. avg.) kN (lb) | Carbon Black Content ASTM D 1603 range (%) [4] | Carbon Black Dispersion ASTM D 5596 [5] | Stress Crack Resistance ASTM D 5397 Appendix [6] | Oxidative Induction Time (OIT) (min. avg.) [7] | | Oven Aging at 85°C ASTM D 5721 [7], [8] | | UV Resistance GM 11 [9] | Manufacturer's Suggested Applications [11] |
|--------------|------------------|--------------------------|---|---|------------------------------------|---------------------------|--------------------|--------------------|--|---|--|---|--|--|-------------------------------|---|-------------------------------------|-------------------------|--|
| | | Roll Width/Length m (ft) | Thickness ASTM D5199 (smooth) ASTM D5994 (textured) min. avg. mm (mils) [2] | | Strength | | Elongation | | | | | | | Standard OIT ASTM D 3895 | High Pressure OIT ASTM D 5885 | ASTM D3895 % retained after 90 days | ASTM D5885 % retained after 90 days | | |
| | | | | | Yield Stress kN/m (lb/in) | Break Stress kN/m (lb/in) | Yield Elongation % | Break Elongation % | | | | | | | | | | | |

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|--------------------------------|---------|--------------------|----------|-------|----------|----------|----|-----|-------------|------------|-----|---------|-----|-----|-----|----|----|----|-----|
| GSE HD Conductive Smooth | HD-CX-S | 6.9/265 (22.5/870) | 1.0 (40) | 0.940 | 15 (84) | 27 (152) | 12 | 700 | 0.320 (72) | 0.125 (28) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Conductive Smooth | HD-CX-S | 6.9/171 (22.5/560) | 1.5 (60) | 0.940 | 22 (126) | 40 (228) | 12 | 700 | 0.480 (108) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Conductive Smooth | HD-CX-S | 6.9/131 (22.5/430) | 2.0 (80) | 0.940 | 29 (168) | 53 (304) | 12 | 700 | 0.640 (144) | 0.249 (56) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Conductive White Smooth | HD-CX-S | 6.9/265 (22.5/870) | 1.0 (40) | 0.940 | 15 (84) | 27 (152) | 12 | 700 | 0.320 (72) | 0.125 (28) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Conductive White Smooth | HD-CX-S | 6.9/171 (22.5/560) | 1.5 (60) | 0.940 | 22 (126) | 40 (228) | 12 | 700 | 0.480 (108) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Conductive White Smooth | HD-CX-S | 6.9/131 (22.5/430) | 2.0 (80) | 0.940 | 29 (168) | 53 (304) | 12 | 700 | 0.640 (144) | 0.249 (56) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Smooth | HD-S | 6.9/265 (22.5/870) | 1.0 (40) | 0.940 | 15 (84) | 27 (152) | 12 | 700 | 0.320 (72) | 0.125 (28) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Smooth | HD-S | 6.9/265 (22.5/870) | 1.5 (60) | 0.940 | 22 (126) | 40 (228) | 12 | 700 | 0.480 (108) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Smooth | HD-S | 6.9/265 (22.5/870) | 2.0 (80) | 0.940 | 29 (168) | 53 (304) | 12 | 700 | 0.640 (144) | 0.249 (56) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Textured | HD-C-T | 6.9/213 (22.5/700) | 1.0 (40) | 0.940 | 15 (84) | 10 (60) | 12 | 100 | 0.267 (60) | 0.125 (28) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Textured | HD-C-T | 6.9/213 (22.5/700) | 1.5 (60) | 0.940 | 22 (126) | 16 (90) | 12 | 100 | 0.400 (90) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Textured | HD-C-T | 6.9/213 (22.5/700) | 2.0 (80) | 0.940 | 29 (168) | 21 (120) | 12 | 100 | 0.534 (120) | 0.249 (56) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD White Smooth | HD-CX-S | 6.9/265 (22.5/870) | 1.0 (40) | 0.940 | 15 (84) | 27 (152) | 12 | 700 | 0.320 (72) | 0.125 (28) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD White Smooth | HD-CX-S | 6.9/171 (22.5/560) | 1.5 (60) | 0.940 | 22 (126) | 40 (228) | 12 | 700 | 0.480 (108) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD White Smooth | HD-CX-S | 6.9/131 (22.5/430) | 2.0 (80) | 0.940 | 29 (168) | 53 (304) | 12 | 700 | 0.640 (144) | 0.249 (56) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD White Textured | HD-CX-T | 6.9/213 (22.5/700) | 1.0 (40) | 0.940 | 15 (84) | 10 (60) | 12 | 100 | 0.267 (60) | 0.125 (28) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD White Textured | HD-CX-T | 6.9/159 (22.5/520) | 1.5 (60) | 0.940 | 22 (126) | 16 (90) | 12 | 100 | 0.400 (90) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD White Textured | HD-CX-T | 6.9/122 (22.5/400) | 2.0 (80) | 0.940 | 29 (168) | 21 (120) | 12 | 100 | 0.534 (120) | 0.249 (56) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |

- [1] HDPE = High density polyethylene
CX = Coextruded
- [2] Lowest individual of 10 values
- [3] Machine direction (MD) and cross machine direction (XD) average values should be on the basis of 5 test specimens each direction
 - Yield elongation calculated with a gage length of 33mm
 - Break elongation calculated with a gage length of 50mm
- [4] Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

- T = Textured
S = Smooth
- [5] Carbon black dispersion for 10 different views:
 - minimum 9 of 10 in Categories 1 or 2
 - all 10 in Categories 1, 2, or 3
- [6] The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- [7] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- [8] It also is recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

- [9] The condition of the test should be 20 hr. UV cycle at 75 C followed by 4 hr. condensation at 60 C.
- [10] UV resistance is based on percent retained value regardless of the original HP-OIT value.
- [11] CL = Canal liner
SIL = Surface impoundment liner
SIC = Surface impoundment cover
LL = Landfill liner
DP = Decorative pond
NP = Not provided by manufacturer
NA = Not applicable, per manufacturer
- DL = Dam liner
LPL = Leach pad liner
LC = Landfill cover
TL = Tunnel liner
RP = Reserve pit

| Product Name | Base Polymer [1] | Dimensional Properties | | Density ASTM D1505/D792 (min.) (g/cm ³ min.) | Tensile Properties ASTM D 6693 [3] | | | | Puncture Resistance D 4833 (min. avg.) kN (lb) | Tear Resistance ASTM D 1004 (min. avg.) kN (lb) | Carbon Black Content ASTM D 1603 range (%) [4] | Carbon Black Dispersion ASTM D 5596 [5] | Stress Crack Resistance ASTM D 5397 Appendix [6] | Oxidative Induction Time (OIT) (min. avg.) [7] | Oven Aging at 85°C ASTM D 5721 [7], [8] | | UV Resistance GM 11 [9] | Manufacturer's Suggested Applications [11] |
|--------------|------------------|--------------------------|---|---|------------------------------------|---------------------------|--------------------|--------------------|--|---|--|---|--|--|---|-------------------------------|-------------------------|--|
| | | Roll Width/Length m (ft) | Thickness ASTM D5199 (smooth) ASTM D5994 (textured) min. avg. mm (mils) [2] | | Strength | | Elongation | | | | | | | | Standard OIT ASTM D 3895 | High Pressure OIT ASTM D 5885 | | |
| | | | | | Yield Stress kN/m (lb/in) | Break Stress kN/m (lb/in) | Yield Elongation % | Break Elongation % | | | | | | | | | | |

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|----------------------------------|---------|--------------------|----------|-------|----------|----------|----|-----|-------------|------------|-----|---------|------|-----|-----|-----|----|----|-----|
| GSE HD Green Smooth | HD-CX-S | 6.9/171 (22.5/560) | 1.5 (60) | 0.940 | 22 (126) | 40 (228) | 12 | 700 | 0.480 (108) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD Green Textured | HD-CX-T | 6.9/159 (22.5/520) | 1.5 (60) | 0.940 | 22 (126) | 16 (90) | 12 | 100 | 0.400 (90) | 0.187 (42) | 2-3 | 1, 2, 3 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| GSE HD High Performance | CX-S | 6.9/265 (22.5/870) | 1.0 (40) | 0.940 | 15 (84) | 27 (152) | 13 | 800 | 0.378 (85) | 0.125 (28) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| GSE HD High Performance | CX-S | 6.9/171 (22.5/560) | 1.5 (60) | 0.940 | 23 (132) | 42 (243) | 13 | 800 | 0.556 (125) | 0.186 (42) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| GSE HD High Performance | CX-S | 6.9/131 (22.5/430) | 2.0 (80) | 0.940 | 31 (177) | 57 (327) | 13 | 800 | 0.711 (160) | 0.257 (58) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| GSE HD Textured High Performance | CX-T | 6.9/265 (22.5/870) | 1.0 (40) | 0.940 | 15 (84) | 13 (75) | 13 | 200 | 0.422 (95) | 0.142 (32) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| GSE HD Textured High Performance | CX-T | 6.9/171 (22.5/560) | 1.5 (60) | 0.940 | 23 (132) | 20 (115) | 13 | 200 | 0.578 (130) | 0.200 (45) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| GSE HD Textured High Performance | CX-T | 6.9/131 (22.5/430) | 2.0 (80) | 0.940 | 31 (177) | 27 (155) | 13 | 200 | 0.711 (160) | 0.266 (60) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |

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|---------------|-----------|-------------------------------|--------------------|------|----------------|----------------|----|-----|----------------------|---------------------|-----|--------|-----|-----|-----|----|----|----|-----|
| Huitex HD, HP | HDPE CX-S | 7-8/70-420 (23-26.2/230-1378) | 0.50-3.00 (20-120) | 0.94 | 9-44 (52-252) | 14-80 (80-456) | 13 | 700 | 0.16-0.96 (36-216) | 0.07-0.38 (16-85) | 2-3 | 1 or 2 | 300 | 100 | 400 | 55 | 80 | 50 | all |
| Huitex HX | HDPE CX-T | 8/76-198 (26.2/250-650) | 0.75-2.5 (30-100) | 0.94 | 11-37 (63-210) | 8-26 (45-150) | 12 | 100 | 0.200-0.668 (45-150) | 0.093-0.312 (21-70) | 2-3 | 1 or 2 | 300 | 100 | 400 | 55 | 80 | 50 | all |

- [1] HDPE = High density polyethylene
CX = Coextruded
- [2] Lowest individual of 10 values
- [3] Machine direction (MD) and cross machine direction (XD) average values should be on the basis of 5 test specimens each direction
• Yield elongation calculated with a gage length of 33mm
• Break elongation calculated with a gage length of 50mm
- [4] Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.
- T = Textured
S = Smooth

- [5] Carbon black dispersion for 10 different views:
• minimum 9 of 10 in Categories 1 or 2
• all 10 in Categories 1, 2, or 3
- [6] The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- [7] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- [8] It also is recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

- [9] The condition of the test should be 20 hr. UV cycle at 75 C followed by 4 hr. condensation at 60 C.
- [10] UV resistance is based on percent retained value regardless of the original HP-OIT value.
- [11] CL = Canal liner
SIL = Surface impoundment liner
SIC = Surface impoundment cover
LL = Landfill liner
DP = Decorative pond
NP = Not provided by manufacturer
NA = Not applicable, per manufacturer
- DL = Dam liner
LPL = Leach pad liner
LC = Landfill cover
TL = Tunnel liner
RP = Reserve pit

| Product Name | Base Polymer [1] | Dimensional Properties | | Density ASTM D1505/D792 (min.) (g/cm ³ min.) | Tensile Properties ASTM D 6693 [3] | | | | Puncture Resistance D 4833 (min. avg.) kN (lb) | Tear Resistance ASTM D 1004 (min. avg.) kN (lb) | Carbon Black Content ASTM D 1603 range (%) [4] | Carbon Black Dispersion ASTM D 5596 [5] | Stress Crack Resistance ASTM D 5397 Appendix [6] | Standard OIT ASTM D 3895 | High Pressure OIT ASTM D 5885 | Oven Aging at 85°C ASTM D 5721 [7], [8] | | UV Resistance GM 11 [9] | Manufacturer's Suggested Applications [11] |
|--------------|------------------|--------------------------|---|---|------------------------------------|---------------------------|--------------------|--------------------|--|---|--|---|--|--------------------------|-------------------------------|---|-------------------|-------------------------|--|
| | | Roll Width/Length m (ft) | Thickness ASTM D5199 (smooth) ASTM D5994 (textured) min. avg. mm (mils) [2] | | Strength | | Elongation | | | | | | | | | Standard OIT | High Pressure OIT | | |
| | | | | | Yield Stress kN/m (lb/in) | Break Stress kN/m (lb/in) | Yield Elongation % | Break Elongation % | | | | | | | | | | | |

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|----------------|----------|-----------------------------|-----------|------|---------|----------|----|-----|----------|----------|-----|---------|-----|-----|-----|----|----|----|-----|
| Herculine HD12 | HDPE - S | 5.95 (19.5)/ 521 (1,710) | 0.30 (12) | 0.94 | 4 (24) | 8 (45) | 12 | 700 | 93 (21) | 35 (8) | 2-3 | 1, 2, 3 | 400 | 100 | 400 | 55 | 80 | 50 | all |
| Herculine HD20 | HDPE - S | 5.79 (19)/ 341 (1,120) | 0.50 (20) | 0.94 | 7 (40) | 13 (76) | 12 | 700 | 160 (36) | 60 (13) | 2-3 | 1, 2, 3 | 400 | 100 | 400 | 55 | 80 | 50 | all |
| Herculine HD30 | HDPE - S | 5.64 (18.5)/ 226 (740) | 0.75 (30) | 0.94 | 11 (63) | 20 (114) | 12 | 700 | 240 (54) | 93 (21) | 2-3 | 1, 2, 3 | 400 | 100 | 400 | 55 | 80 | 50 | all |
| Herculine HD40 | HDPE - S | 5.49 (18)/ 169 (556) | 1.00 (40) | 0.94 | 15 (84) | 27 (152) | 12 | 700 | 320 (72) | 125 (28) | 2-3 | 1, 2, 3 | 400 | 100 | 400 | 55 | 80 | 50 | all |

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|--------------|------|----------------------------------|----------------|-------|-------------------|--------------------|----|-----|----------------------|-----------------------|-----|--------|------|-----|-----|-----|----|-----|-----|
| Carbofol 406 | S, T | 5.10-9.40/100 (16.7-30.8/330) | 1-2.5 (40-100) | 0.942 | 15-37 (84-212) | 27-70 (150-400) | 12 | 700 | 0.32-0.8 (72-180) | 0.12-0.311 (28-70) | 2-3 | 1 or 2 | >300 | 100 | 400 | >55 | 80 | >50 | all |
| Carbofol 507 | S, T | 5.10-9.40/100 (16.7-30.8/330) | 1-2.5 (40-100) | 0.942 | 15-37 (84-212) | 27-70 (150-400) | 12 | 700 | 0.32-0.8 (72-180) | 0.12-0.311 (28-70) | 2-3 | 1 or 2 | >300 | 70 | NA | NA | NA | NP | all |

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|-------------|------|-------------------------|-----------|--------|--------------|-----------|----|-----|------------|-----------|-----|-----|-----|-----|----|----|----|----|-----|
| Solmax 440 | S | 6.8/237.7 (22.3/780) | 1.0 (40) | > 0.94 | 15 (84) | 28 (162) | 13 | 700 | 0.35 (80) | 0.12 (28) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 440T | CX-T | 6.8/237.7 (22.3/780) | 0.95 (38) | > 0.94 | 15.3 (88) | 15.3 (88) | 12 | 150 | 0.40 (90) | 0.13 (30) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 460 | S | 6.8/158.5 (22.3/520) | 1.5 (60) | > 0.94 | 22 (130) | 42 (243) | 13 | 700 | 0.54 (122) | 0.19 (42) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 460T | CX-T | 6.8/164.6 (22.3/540) | 1.43 (57) | > 0.94 | 23 (132) | 23 (132) | 13 | 150 | 0.53 (120) | 0.20 (45) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 480 | S | 6.8/121.9 (22.3/400) | 2.0 (80) | > 0.94 | 31 (177) | 57 (326) | 13 | 700 | 0.70 (155) | 0.25 (57) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 480T | CX-T | 6.71/128 (22.0/420) | 1.90 (76) | > 0.94 | 30 (176) | 29 (167) | 13 | 150 | 0.66 (150) | 0.26 (60) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 500 | S | 6.8/97.5 (22.0/320) | 2.5 (100) | > 0.94 | 37 (210) | 67 (380) | 12 | 700 | 0.80 (180) | 0.31 (70) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |
| Solmax 500T | CX-T | 6.71/97.5 (22.0/320) | 2.38 (95) | > 0.94 | 37 (210) | 26 (150) | 12 | 100 | 0.66 (150) | 0.31 (70) | 2-3 | 1-2 | 400 | 100 | NA | NA | 80 | 50 | all |

- [1] HDPE = High density polyethylene
CX = Coextruded
- [2] Lowest individual of 10 values
- [3] Machine direction (MD) and cross machine direction (XD) average values should be on the basis of 5 test specimens each direction
 - Yield elongation calculated with a gage length of 33mm
 - Break elongation calculated with a gage length of 50mm
- [4] Other methods such as D 4218 (muffle furnace) or microwave methods are acceptable if an appropriate correlation to D 1603 (tube furnace) can be established.

- [5] Carbon black dispersion for 10 different views:
 - minimum 9 of 10 in Categories 1 or 2
 - all 10 in Categories 1, 2, or 3
- [6] The yield stress used to calculate the applied load for the SP-NCTL test should be the manufacturer's mean value via MQC testing.
- [7] The manufacturer has the option to select either one of the OIT methods listed to evaluate the antioxidant content in the geomembrane.
- [8] It also is recommended to evaluate samples at 30 and 60 days to compare with the 90 day response.

- [9] The condition of the test should be 20 hr. UV cycle at 75 C followed by 4 hr. condensation at 60 C.
- [10] UV resistance is based on percent retained value regardless of the original HP-OIT value.
- [11] CL = Canal liner
SIL = Surface impoundment liner
SIC = Surface impoundment cover
LL = Landfill liner
DP = Decorative pond
NP = Not provided by manufacturer
NA = Not applicable, per manufacturer
- DL = Dam liner
LPL = Leach pad liner
LC = Landfill cover
TL = Tunnel liner
RP = Reserve pit

| Product Name | Polymer Type | Dimensional Properties | | Specific Gravity ASTM D792 | Dimensional Stability ASTM D1204 % | Puncture Resistance ASTM D4833 kN (lb) | Tear Resistance STM D1004 Die C kN (lb) | Tensile Properties ASTM D638 | | | | Low Temperature Brittleness ASTM D2136 °C | Suggested Seam Strength ASTM D4545 | | Carbon Black Content ASTM D1603 | Manufacturer's Suggested Applications [1] |
|--|------------------------|--|-------------------------------|----------------------------|------------------------------------|--|---|------------------------------|--------------------|------------|----------|---|------------------------------------|---------------------|---------------------------------|---|
| | | Maximum Panel Size m ² (ft ²) | Thickness ASTM D751 mm (mils) | | | | | Strength | | Elongation | | | Shear kN/m (lb/in) | Peel kN/m (lb/in) | | |
| | | | | | | | | Yield kN/m (lb/in) | Break kN/m (lb/in) | Yield % | Break % | | | | | |
| Atarfil S.L. www.atarfil.com | | | | | | | | | | | | | | | | |
| ATARPOL | PP | 420–1260 | 1.00–2.50 | ≥ 0,88 | ±1,50 | 0.13–0.32 | 0,06-13 | NA | > 13 | NA | ≥700 | -40 | NP | NP | 2–2,5 | CL, SIC, LPL, LC, RP, SIL |
| ATARPOL S Coextruded | PP | 420–1260 | 1.00–2.50 | ≥ 0,88 | ±1,50 | 0.13–0.32 | 0,06-13 | NA | > 13 | NA | ≥700 | -40 | NP | NP | 2–2,5 | CL, SIL, SIC, DP, RP |
| Carlisle Syntec Geomembranes www.carlislegeomembrane.com | | | | | | | | | | | | | | | | |
| Geo PolyPro (Reinforced) tan, white, black | Flexible Polypropylene | 3.66 x 183 (12 x 600) | 0.82 (32.4) min. | 0.95 min. | +/- 1.0 max. | 0.378 (85) min. | not applicable (NA) | NA | NA | NA | NA | -40 max. | breaks outside weld | 5.3 (30) min. | 2.75 black only | CL, SIL, SIC, LC, DL, LPL, TL |
| Geo PolyPro (Reinforced) tan, white, black | Flexible Polypropylene | 3.66 x 183 (12 x 600) | 1.03 (40.5) min. | 0.95 min. | +/- 1.0 max. | 0.378 (85) min. | NA | NA | NA | NA | NA | -40 max. | breaks outside weld | 5.3 (30) min. | 2.75 black only | CL, SIL, SIC, LC, DL, LPL, TL |
| Geo PolyPro (Reinforced) tan, white, black | Flexible Polypropylene | 3.66 x 122 (12 x 400) | 1.37 (54.0) min. | 0.95 min. | +/- 1.0 max. | 0.378 (85) min. | NA | NA | NA | NA | NA | -40 max. | breaks outside weld | 5.3 (30) min. | 2.75 black only | CL, SIL, SIC, LC, DL, LPL, TL |
| GeoFlashing (Non-reinforced) tan, white, black | Flexible Polypropylene | 3.66 x 61 (12 x 200) | 0.91 (36.0) min. | 0.95 min. | +/- 1.0 max. | 0.133 (30) min. | 0.0533 (12) min. | NA | 12.6 (72) min. | NA | 700 min. | -40 max. | breaks outside weld | breaks outside weld | 2.75 black only | CL, SIL, SIC, LC, DL, LPL, TL |
| GeoFlashing (Non-reinforced) tan, white, black | Flexible Polypropylene | 3.66 x 61 (12 x 200) | 1.37 (54.0) min. | 0.95 min. | +/- 1.0 max. | 0.133 (30) min. | 0.0533 (12) min. | NA | 12.6 (72) min. | NA | 700 min. | -40 max. | breaks outside weld | breaks outside weld | 2.75 black only | CL, SIL, SIC, LC, DL, LPL, TL |
| Cooley Group www.cooleygroup.com | | | | | | | | | | | | | | | | |
| CoolPro-UPP30 | fPP | Width = 65 to 150 in (1.6 to 3.8 m) | 0.75 (30) | 0.9 | 1 | 0.11 (25) | 0.04 (10) | NP | 10 (54) | NP | 700 | -40 | NP | NP | NP | CL, SIC, SIL, TL, DP, LL, LPL, DL, LC |
| CoolPro-UPP40 | fPP | Width = 65 to 150 in (1.6 to 3.8 m) | 1.0 (40) | 0.9 | 1 | 0.13 (30) | 0.05 (12) | NP | 13 (72) | NP | 700 | -40 | NP | NP | NP | CL, SIC, SIL, TL, DP, LL, LPL, DL, LC |
| CoolPro-UPP100 | fPP | Width = 65 to 150 in (1.6 - 3.8 m) | 2.5 (100) | 0.9 | -0.5 | 0.30 (68) | 0.19 (43) | NP | 33 (180) | NP | 700 | -40 | NP | NP | NP | CL, SIC, SIL, TL, DP, LL, LPL, DL, LC |

[1] CL = Canal liner
DL = Dam liner
DP = Decorative Pond
LPL = Leach pad liner

LC = Landfill cover
LL = Landfill liner
TL = Tunnel liner
SIL = Surface impoundment liner
SIC = Surface impoundment cover

[2] Cannot separate
NP = Not provided by manufacturer
NA = Not applicable, per manufacturer

| Product Name | Polymer Type | Dimensional Properties | | Specific Gravity ASTM D792 | Dimensional Stability ASTM D1204 % | Puncture Resistance ASTM D4833 kN (lb) | Tear Resistance STM D1004 Die C kN (lb) | Tensile Properties ASTM D638 | | | | Low Temperature Brittleness ASTM D2136 °C | Suggested Seam Strength ASTM D4545 | | Carbon Black Content ASTM D1603 | Manufacturer's Suggested Applications [1] |
|---|-------------------|--|-------------------------------|----------------------------|------------------------------------|--|---|------------------------------|---------------------|------------|---------|---|------------------------------------|-------------------|-----------------------------------|---|
| | | Maximum Panel Size m ² (ft ²) | Thickness ASTM D751 mm (mils) | | | | | Strength | | Elongation | | | Shear kN/m (lb/in) | Peel kN/m (lb/in) | | |
| | | | | | | | | Yield kN/m (lb/in) | Break kN/m (lb/in) | Yield % | Break % | | | | | |
| Engineered Polymer Technologies www.epttech.com | | | | | | | | | | | | | | | | |
| TPO - PP | Width 60" to 120" | 20* to 120 mills *data listed is min. value for 20 mil Product. | 0.9 | 0.5 | 10 lb* | 9 lb* | NA | 70* | NA | 700 | -40 | 25* | 15* | >2.5 | CL, SIL, SIC, LL, DL, LPL, LC, TL | |
| Firestone Specialty Products www.firestonesp.com | | | | | | | | | | | | | | | | |
| fPP Geomembrane | PP | 465 m ² (5000ft ²) | 1.01mm (0.040") | 0.896 | 3% | 110N (25lb) | 45N (10lb) | na | 10.5 kN/m (60lb/ft) | na | 600% | -40 | 10.5 kN/m (60 lb/ft) | na | 3% typical | NP |
| Layfield Geosynthetics & Industrial Fabric Ltd. www.layfieldgroup.com | | | | | | | | | | | | | | | | |
| GeoFlex 20 | O/C | 4650(50,000) | 0.51(20) | NA | 2 | 0.067(22) | 0.031(7) | NA | 13(76) | NA | 1200 | -50 | 4.9(28) | 3.0(17) | >2 | CL, SIL, SIC, DL, LC, TL |
| GeoFlex 30 | O/C | 3200(34,000) | 0.76(30) | NA | 2 | 0.11(34) | 0.049(11) | NA | 20(114) | NA | 1200 | -50 | 7.4(42) | 4.4(25) | >2 | CL, SIL, SIC, DL, LC, TL |
| GeoFlex 40 | O/C | 2300(25,000) | 1.0(40) | NA | 2 | 0.134(45) | 0.067(15) | NA | 26(152) | NA | 1200 | -50 | 8.9(52) | 5.8(33) | >2 | CL, SIL, SIC, DL, LC, TL |
| Raven Industries Inc. www.ravengeo.com | | | | | | | | | | | | | | | | |
| Rufco PP40 | Flexible PP | 2,300 (25,000) | 0.91 (36) | 0.9 | ±2 | 0.18 (41) | 0.058 (13) | NA | 14 (82) | NA | 700 | -40 | 8.9 (51) | 5.6 (32) | 2 | CL, LPL, SIC, LC, TL, SIL, DP |

[1] CL = Canal liner
DL = Dam liner
DP = Decorative Pond
LPL = Leach pad liner

LC = Landfill cover
LL = Landfill liner
TL = Tunnel liner
SIL = Surface impoundment liner
SIC = Surface impoundment cover

[2] Cannot separate
NP = Not provided by manufacturer
NA = Not applicable, per manufacturer

| Product Name | [1] Polymer Type | Dimensional Properties | | Specific Gravity ASTM D792 | Dimensional Stability ASTM D1204 % | Tear Resistance ASTM D1004 Die C kN (lb) | Tensile Properties [2] ASTM D882 | | Hydrostatic Resistance ASTM D751 Method A kPa (lb/in2) | Low Temperature Brittleness ASTM D1790 °C | Manufacturer's Sug- gested Applications [3] |
|---|--------------------------------------|---|---|-------------------------------|---------------------------------------|--|-------------------------------------|-----------------------|--|---|--|
| | | Roll Width/ Length m (ft) | Thickness ASTM D1593 or D5199 mm (mil) | | | | MD kN/m (lb/in) | XD kN/m (lb/in) | | | |
| Carlisle Syntec Geomembranes www.carlislegeomembrane.com | | | | | | | | | | | |
| Geo-EPDM | EPDM | 15.24x60.96 (50x200) | 45 mil | 1.1 | +/- 1 | .040 (9) | 9.6 (55 lb/in) | 9.6 (55 lb/in) | NA | -67 | CL, SC, LC, DL, LPL, TL, SIL |
| Geo-EPDM | EPDM | 15.24x45.72 (50x150) | 60 mil | 1.1 | +/- 1 | .050 (12) | 11.4 (65 lb/in) | 11.4 (65 lb/in) | NA | -67 | CL, SC, LC, DL, LPL, TL, SIL |
| Cooley Group www.cooleygroup.com | | | | | | | | | | | |
| CoolGuard-UcG40 | EIA | Width = 65 to 150 in (1.6 to 3.8 m) | 1.0 (40) | 1.2 | 5 | 0.30 (67) | 0.09 (20) | NP | 13 (72) | NP | 350 |
| CoolGuard-UcG80 | EIA | Width = 65 to 150 in (1.6 to 3.8 m) | 2.0 (80) | 1.2 | 5 | 0.59 (133) | 0.18 (40) | NP | 25 (144) | NP | 350 |
| Engineered Polymer Technologies www.epttech.com | | | | | | | | | | | |
| EPT Xtrm Ply Fpvc | PVC - GP, NSF 51 and/or ASTM-7176 | Width 60" to 120" | 20" to 120 mills *data listed is min. value for 20 mil Product. | 1.3 | 0.5 | 10* | 50* | 50* | 80* | -30 | CL, SIL, SIC, LL, LPL, DL SR, SC, LC, TL |
| EPT Xtrm Ply Feia | EIA | Width 60" to 120" | 20" to 120 mills *data listed is min. value for 20 mil Product. | 1.2 | 0.5 | 10* | 50* | 50* | 80* | -40 | CL, SIL, SIC, SR, SC, LC, LPL, TL |
| Firestone Specialty Products www.firestonesp.com | | | | | | | | | | | |
| EPDM Geomembrane | EPDM | 3.05–15.25 x 15.25–61 (10–50 x 50–200) | 1.15–1.5 (0.045"–0.060") | 1.15 | ±1% | 0.040 kN(9lb) min ave for 45 mil | 9.6 kN/m (55lb/in) | 9.6 kN/m (55lb/in) | 551kPa (80psi) | -45 | CL, SC, LC, DL, SIL |
| PondGard | EPDM | 3.05–15.25 x 15.25–61 (10–50 x 50–200) | 1.15 (0.045") | 1.15 | ±1% | 0.040kN (9lb) min ave for 45 mil | 9.6 kN/m (55lb/in) | 9.6 kN/m (55lb/in) | 551kPa (80psi) | -45 | CL, SC, LC, DL, SIL |
| Layfield Geosynthetics & Industrial Fabric Ltd. www.layfieldgroup.com | | | | | | | | | | | |
| Arctic Liner 30 | O/C | 1.83/261 (6/855) | 0.76 +/-5% (30) | 1.15 | 4 | 0.027 (6) | 9.98 (57) | 8.93 (51) | 420 (61) | -54 | SC, SR, SIL, LL, LPL |
| HAZGARD 100 | O/C | 1.83/261 (6/855) | 0.76 +/-5% (30) | 1.15 | 5 | 0.027 (6) | 9.98 (57) | 8.93 (51) | 420 (61) | -30 | SC, SR, SIL, LL, LPL |
| SealEco www.sealeco.com | | | | | | | | | | | |
| Elastoseal EPDM | EPDM/ TPE | 1.7/100 (5.5/330) | 0.8, 1.0, 1.2, (31, 39, 47) | 1.16 | ±1 | 30 | 10/400 (57/400) | 10/400 (57/400) | 610 | -50 | CL, LC, TL, DL |
| Solmax International Inc. www.solmax.com | | | | | | | | | | | |
| Solmax 230 | PVC | 2.16/303.6 (7.08/996) | 0.75 (30) | 1.2 | 3 | 0.035 (8) | 12.8 (73) | 12.8 (73) | 690 (100) | -29 (-20) | CL, SIL, SIC, LL, LC, LPL, DL |
| Solmax 240 | PVC | 2.16/224 (7.08/735) | 1.00 (40) | 1.2 | 3 | 0.044 (10) | 17.0 (97) | 17.0 (97) | 830 (120) | -29 (-20) | CL, SIL, SIC, LL, LC, LPL, DL |
| Solmax 260 PG | PVC - POTABLE GRADE | 1.55/128 (5.08/420) | 1.50 (60) | 1.2 | 4 | 0.044 (10) | 17.5 (100) | 17.5 (100) | 621 (90) | -20 (-4) | CL, SIL, SIC, LL, LC, LPL, DL |
| Solmax 220 FG | PVC - FISH GRADE | 1.83/384 (6.00/1,260) | 0.50 (20) | NP | NP | 0.017 (4) | 5.3 (30) | 5.3 (30) | NP | NP | CL, SIL, SIC, LL, LC, LPL, DL |

[5] PVC = Polyvinyl chloride
PVC-R = Polyvinyl chloride-reinforced

[2] MD = Machine direction
XD = Cross-machine direction

[3] CL = Canal liner
SC = Secondary containment
SR = Soil remediation
SIL = Surface impoundment liner
SIC = Surface impoundment cover

LL = Landfill liner
LC = Landfill cover
DL = Dam liner
LPL = Leach pad liner
TL = Tunner liner

NP = Not provided by manufacturer
NA = Not applicable, per manufacturer

Unless otherwise indicated, these are minimum average roll values (MARV). All claims are the responsibility of the manufacturer.

| Product Name | Polymer Type [1] (membrane) | Polymer Type [1] (reinforcement) | Dimensional Properties | | Specific Gravity ASTM D792 | Ply Adhesion ASTM D413 MD kN/m (lb/in) | Dimensional Stability ASTM D1204 % | Puncture Resistance FTMS 101C Method 2031 kN (lb) | Tear Resistance ASTM D5884 Method B Tongue Tear kN (lb) | Tensile Strength ASTM D751 [2] kN (lb) | Hydrostatic Resistance ASTM D751 [2] Method A kN/m ² (lb/in ²) | Low Temperature Brittleness ASTM D1790 °C | Suggested Seam Strength | | Manufacturer's Suggested Applications [4] |
|--|-----------------------------|----------------------------------|--|--|----------------------------|---|---------------------------------------|--|---|---|--|--|-------------------------------------|--------------------------------|--|
| | | | Maximum Panel Size Roll Width/Length m/m (ft/ft) | Thickness ASTM 1593 or D5199 mm (mil) | | | | | | | | | Shear ASTM D751 [3] kN/m (lb/in) | Peel ASTM D413 kN/m (lb/in) | |
| Atarfil S.L. www.atarfil.com | | | | | | | | | | | | | | | |
| ATARPOLRS | PP | PP | 2.00/15-20 | 1,00-1,5 | NP | NA | <0.5 | NA | NA | NA | NA | -40 | NA | NA | CL, SIL, SIC, DP, RP, ROOFING |
| ATARTEC RSP | Thermoplastic polyolefines | PS | 2.00/15-20 | 1,2-1,5-2,00 | NP | NA | ≤0.3 | NA | NA | NA | NA | -40 | NA | NA | ROOFING |
| ATARTEC RSV | Thermoplastic polyolefines | Glass fiber | 2.00/15-20 | 1,2-1,5-2,00 | NP | NA | ≤0.5 | NA | NA | NA | NA | -40 | NA | NA | ROOFING |
| Burke Industries www.burkeind.com | | | | | | | | | | | | | | | |
| M283 | CSPE | PET | NP | 36 | NP | -8 | NA | (240)* | (100)** | -275 | (405)[3] | -45 F[5] | NA | NA | NP |
| M284 | CSPE | PET | NP | 45 | NP | -10 | NA | (250)* | (105)** | -280 | (415)[3] | -45 F[5] | NA | NA | NP |
| Cooley Group www.cooleygroup.com | | | | | | | | | | | | | | | |
| CoolGuard FTL30 | EIA | PET | Width up to 150 in (3.8 m) | 0.91 (36) | NP | 2.6 (15) | 1 | 1.45 (325) | 0.13 (30) | 2.7 x 2.7 (600 x 600) | 6897 (1,000) | -34 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolGuard FTL40N | EIA | PET | Width up to 150 in (3.8 m) | 1.17 (46) | NP | 3.5 (20) | 1 | 2.45 (550) | 0.22 (50) | 4.4 x 4.4 (1,000 x 1,000) | 6897 (1,000) | -34 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolGuard HPK80 | EIA | PET | Width up to 150 in (3.8 m) | 2.03 (80) | NP | 1.7 (10) | 2.5 | 0.89 (200) | 0.13 (30) | 1.1 x 0.9 (250 x 200) | 2413 (350) | -34 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolGuard HRL36 | EIA | PET | Width up to 150 in (3.8 m) | 0.91 (36) | NP | 2.1 (12) | 2.5 | 1.67 (375) | 0.53 (120) | 2.8 x 2.7 (625 x 600) | 5517 (800) | -40 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolGuard MPK36 | EIA | PET | Width up to 150 in (3.8 m) | 0.91 (36) | NP | 1.8 (10) | 2.5 | 0.89 (200) | 0.18 (40) | 1.1 x 0.9 (250 x 200) | 2413 (350) | -25 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolGuard MPK60 | EIA | PET | Width up to 150 in (3.8 m) | 1.52 (60) | NP | 1.7 (10) | 2 | 0.89 (200) | 0.13 (30) | 1.1 x 0.9 (250 x 200) | 2413 (350) | -29 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolFlex PW36 | PVC | PET | Width up to 150 in (3.8 m) | 0.91 (36) | NP | 1.8 (10) | 2.5 | 0.89 (200) | 0.18 (40) | 1.1 x 0.9 (250 x 200) | 2413 (350) | -25 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolPro 45 | PP | PET | Width = 78 or 150 in (2.0 or 3.8 m) | 1.14 (45) | 0.9 | 3.5 (20) | 1 | 1.33 (300) | 0.31 (70) | 1.3 x 1.1 (300 x 250) | 2413 (350) | -40 | NP | NP | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| CoolPro 60 | PP | PET | Width = 78 or 150 in (2.0 or 3.8 m) | 1.52 (60) | 0.9 | 3.5 (20) | 1 | 1.33 (300) | 0.31 (70) | 1.3 x 1.1 (300 x 250) | 2413 (350) | -40 | NP | NP | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| EnviroFlex PW20 | PP | PP | Width = 78 or 150 in (2.0 or 3.8 m) | 0.50 (20) | 0.9 | 3.5 (20) | 2 | 0.89 (200) | 0.11 (25) | 0.89 x 0.84 (200 x 190) | 1206 (175) | -40 | NP | NP | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| EnviroFlex PW36 | PP | PP | Width = 78 or 150 in (2.0 or 3.8 m) | 0.91 (36) | 0.9 | 3.5 (20) | 2 | 0.89 (200) | 0.11 (25) | 1.1 x 1.1 (250 x 240) | 2413 (350) | -40 | NP | NP | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| EnviroFlex PW45 | PP | PP | Width = 78 or 150 in (2.0 or 3.8 m) | | | 3.5 (20) | 2 | 0.89 (200) | 0.11 (25) | 1.2 x 1.2 (280 x 270) | 2413 (350) | -40 | NP | NP | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| CoolThane FML 87 | Urethane | PET | Width = 60 to 68 in (1.5 to 1.7 m) | 0.89 (35) | NP | 3.5 (20) | 2 | NP | 0.67 (150) | 1.8 x 1.6 (400 x 350) | 3447 (500) | -43 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolThane L1023DEP | Urethane | PET | Width = 60 to 68 in (1.5 to 1.7 m) | 0.76 (30) | NP | 3.0 (17.5) | 2 | NP | 0.71 (160) | 1.6 x 1.3 (350 x 300) | 2758 (400) | -54 | NP | NP | SIL, SIC, SR, SC, LC, TL |

[1] PVC = Polyvinyl chloride
 CPE = Chlorinated polyethylene
 CSPE = Chlorosulfonated polyethylene
 EIA = Ethylene interpolymer alloy
 fPP = Flexible polypropylene
 HDPE = High density polyethylene
 HDPE-T = High density polyethylene, textured

LLDPE = Linear low density polyethylene
 LLDPE-T = Linear low density polyethylene, textured
 PET = Polyester
 PP = Polypropylene
 O/C = Other or combination
 TPO = Thermoplastic polyolefin

[2] As modified in NSF 54, appendix A
 Note: NSF 54 has been withdrawn.

[3] Method A, Procedure I
 [4] CL = Canal liner
 DP = Decorative pond
 ILC = Interim landfill cover
 LC = Landfill cover
 LL = Landfill liner
 LPL = Leach pad liner
 RP = Reserve pit

RSC = Rain shed cover
 SIL = Surface impoundment liner
 SIC = Surface impoundment cover
 TL = Tunnel liner
 NP = Not provided by manufacturer
 NA = Not applicable, per manufacturer

* = FTMS 101B
 ** = ASTM D751
 *** = ASTM D4833
 **** = ASTM D7003

| Product Name | Polymer Type [1] (membrane) | Polymer Type [1] (reinforcement) | Dimensional Properties | | Specific Gravity ASTM D792 | Ply Adhesion ASTM D413 MD kN/m (lb/in) | Dimensional Stability ASTM D1204 % | Puncture Resistance FTMS 101C Method 2031 kN (lb) | Tear Resistance ASTM D5884 Method B Tongue Tear kN (lb) | Tensile Strength ASTM D751 [2] kN (lb) | Hydrostatic Resistance ASTM D751 [2] Method A kN/m ² (lb/in ²) | Low Temperature Brittleness ASTM D1790 °C | Suggested Seam Strength | | Manufacturer's Suggested Applications [4] |
|--|---|----------------------------------|--|--|----------------------------|---|---------------------------------------|--|--|---|--|--|-------------------------------------|--------------------------------|--|
| | | | Maximum Panel Size Roll Width/Length m/m (ft/ft) | Thickness ASTM 1593 or D5199 mm (mil) | | | | | | | | | Shear ASTM D751 [3] kN/m (lb/in) | Peel ASTM D413 kN/m (lb/in) | |
| Cooley Group www.cooleygroup.com | | | | | | | | | | | | | | | |
| CoolThane L1612ESU | Urethane | PET | Width=60 to 68 in (1.5 to 1.7 m) | 0.50 (20) | NP | 2.6 (15) | 2 | NP | 0.29 (65) | 1.4 x 1.1 (325 x 250) | 3448 (500) | -43 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolThane L4490NESU | Urethane | Nylon | Width=60 to 68 in (1.5 to 1.7 m) | 1.4 (54) | NP | 2.6 (15) | 2 | NP | 0.18 (40) | 5.3 x 4.9 (1,200 x 1,100) | 4138 (600) | -46 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolThane L2838UPW | Urethane | PET | Width=60 to 68 in (1.5 to 1.7 m) | NP | NP | 1.8 (10) | 2 | NP | 0.12 (26) | 2.4 x 2.4 (550 x 550) | NP | -34 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| CoolShield 40 | PVDF | Fiber glass | Width=60 to 68 in (1.5 to 1.7 m) | 1.01 (40) | NP | 5.2 (30) | 1 | NP | 0.18 (40) | 0.9 X 0.7 (200 X 150) | 1558 (225) | -29 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| Engineered Polymer Technologies www.epttech.com | | | | | | | | | | | | | | | |
| EPT Xtrm Ply TPU | TPU - Ester or Ether* - *data listed is min. value for 30 mil TPU Ether / PET Product. | PET* or Nylon | 60" - 120" | 30* to 120 | 1.1* - 1.2 | 15* | 2 | 400* | 75* | 200* | 450* | -40 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| EPT Xtrm Ply Pro | TPO - PP - *data listed is min. value for 20 mil Product. | PET | 60" - 120" | 20* to 120 | 0.9 | 15* | 1 | 350* | 70* | 200* | 400* | -40 | NP | NP | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| EPT Xtrm Ply PVC | PVC - GP, NSF 51 or ASTM 7176 - *data listed is min. value for 20 mil Product. | PET | 60" - 120" | 20* to 120 | 1.3 | 12* | 0.5 | 350* | 70* | 200* | 400* | -30 | NP | NP | CL, SIL, SIC, LL, LPL, DL, SR, SC, LC, TL |
| EPT Xtrm Ply EIA | EIA - GP, NSF 51 or ASTM 7176 - *data listed is min. value for 20 mil Product. | PET | 60" - 120" | 20* to 120 | 1.2 | 12* | 0.5 | 350* | 70* | 200* | 400* | -45 | NP | NP | CL, SIL, SIC, SR, SC, LC, LPL, TL |
| EPT Xtrm Ply EIA HP | EIA - GP, NSF 51 or ASTM 7176 - *data listed is min. value for 30 mil Product. | PET | 60" - 120" | 30* to 120 | 1.2 | 12* | 0.5* | 600* | 140* | 475* | 750* | -45 | NP | NP | CL, SIL, SIC, SR, SC, LC, LPL, TL |
| Firestone Specialty Products www.firestonesp.com | | | | | | | | | | | | | | | |
| fPP-R Geomembrane | fPP | PET | 465 m ² (5,000 ft ²) | 0.9mm (36) | 0.9 | 3.5kN/m (20 lb/in) | + / - 1% | 0.33 kN (75 lb) | 0.25 kN (55lb) | NP | 2812 kN (400psi) min ave | -40 | NP | NP | NP |
| fPP-R Geomembrane | fPP | PET | 372 m ² (4,000 ft ²) | 1.15 mm (45) | 0.9 | 3.5kN/m (20 lb/in) | + / - 1% | 0.38 kN (85lb) | 0.25 kN (55lb) | NP | 2812 kN (400 psi) min ave | -40 | NP | NP | NP |
| fPP-R Geomembrane | fPP | PET | 279m ² (3,000ft ²) | 1.52 mm (60) | 0.9 | 3.5kN/m (20 lb/in) | + / - 1% | 0.53 kN (118lb) | 0.25 kN (55lb) | NP | 2812 kN (400 psi) min ave | -40 | NP | NP | NP |
| EPDM-R Geomembrane | EPDM | PET | 3.0 x 30 (10 x 100) | 1.15mm (45) | 1.15 | 1.2kn/m (7lb/in) | + / - 1% | 1.20 kN (270 lb) | 0.58 kN (130lb) | 0.85 kN (190lb) | NP | -45 | NP | NP | NP |
| EPDM-R Geomembrane | EPDM | PET | 3.0 x 30 (10 x 100) | 1.5 mm (60) | 1.15 | 1.2kn/m (7lb/in) | + / - 1% | 1.56 kN (350 lb) | 0.75 kN (168lb) | 0.98 kN (220lb) | NP | -45 | NP | NP | NP |
| TPO Geomembrane | TPO | PET | 3.0 x 30 (10 x 100) | 1.15mm (45) | 1.04 | 3.5kN/m (20 lb/in) | + / - 1% | NP | 0.38kN (86lb) | 1.56kN (350lb) | NP | -45 | NP | NP | NP |

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 CPE = Chlorinated polyethylene
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 O/C = Other or combination
 TPO = Thermoplastic polyolefin

[2] As modified in NSF 54, appendix A Note: NSF 54 has been withdrawn.
 [3] Method A, Procedure I
 [4] CL = Canal liner
 DP = Decorative pond
 ILC = Interim landfill cover
 LC = Landfill cover
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 RP = Reserve pit

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 SIL = Surface impoundment liner
 SIC = Surface impoundment cover
 TL = Tunnel liner
 NP = Not provided by manufacturer
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* = FTMS 101B
 ** = ASTM D751
 *** = ASTM D4833
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| Product Name | Polymer Type [1] (membrane) | Polymer Type [1] (reinforcement) | Dimensional Properties | | Specific Gravity ASTM D792 | Ply Adhesion ASTM D413 MD kN/m (lb/in) | Dimensional Stability ASTM D1204 % | Puncture Resistance FTMS 101C Method 2031 kN (lb) | Tear Resistance ASTM D5884 Method B Tongue Tear kN (lb) | Tensile Strength ASTM D751 [2] kN (lb) | Hydrostatic Resistance ASTM D751 [2] Method A kN/m ² (lb/in ²) | Low Temperature Brittleness ASTM D1790 °C | Suggested Seam Strength | | Manufacturer's Suggested Applications [4] |
|--------------|-----------------------------|----------------------------------|--|--|----------------------------|---|---------------------------------------|--|---|---|--|--|-------------------------------------|--------------------------------|--|
| | | | Maximum Panel Size Roll Width/Length m/m (ft/ft) | Thickness ASTM 1593 or D5199 mm (mil) | | | | | | | | | Shear ASTM D751 [3] kN/m (lb/in) | Peel ASTM D413 kN/m (lb/in) | |

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| | | | | | | | | | | | | | | | |
|-------------|----|----|-------------------------|----|------|----|-----|----|-----------|--------------------------|-----------|-----|------------------|-----|----|
| Hercushield | PE | PE | 120,000 ft ² | 12 | 0.93 | NA | 3.6 | NA | 0.27 (60) | 0.9 x 0.6 (200 x 135) | 800 (120) | -40 | 10.5 (5) (60) | FTB | NP |
|-------------|----|----|-------------------------|----|------|----|-----|----|-----------|--------------------------|-----------|-----|------------------|-----|----|

Layfield Geosynthetics & Industrial Fabric Ltd. | www.layfieldgroup.com

| | | | | | | | | | | | | | | | |
|-----------------|-----|-----|--|-----------|-----|----------|-----|------------|-----------|-------------------|------------|-----|-------------------|----------|---------|
| HAZGARD 250 | O/C | PET | 1,250 m ² (13,000 ft ²) | 0.90 (36) | NA | NA | 2.5 | 0.67 (150) | 0.10 (22) | 0.80 kN (180 lb) | 2200 (320) | -30 | 17.5 [5] (100) | 3.5 (20) | SC, SIL |
| HAZGARD 1000 | O/C | PET | 2,300 m ² (25,000 ft ²) | 0.62 (25) | NA | 3.5 (20) | 2 | 1.25 (280) | 0.40 (90) | 1.55 kN (350 lb) | 3100 (450) | -40 | 26.3 [5] (150) | 2.6 (15) | SC |
| HAZGARD 5000 HT | O/C | PET | 1250 m ² (13,000 ft ²) | 0.85 (34) | N/A | N/A | N/A | N/A | N/A | 2.67 kN (600 lbs) | 4140 (800) | N/A | NP | NP | NP |

Raven Industries | www.ravengeo.com

| | | | | | | | | | | | | | | | |
|-------------------|-----------------------|-----|--|-------------|----|----------|-----|------------|------------|------------|-------------|------|----------|----------|-------------------------------|
| Dura-Skrim K30B | LLDPE | PET | 3700M ² (40,000 ft ²) | 0.69 (27) | NP | 3 (17) | <1% | .38 (85)* | 0.77 (173) | 28 (162)* | NP | <-40 | 9.6 (55) | 7 (40) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim K36B | LLDPE | PET | 2800M ² (30,000 ft ²) | 0.81 (32) | NP | 3.6 (21) | <1% | .49 (110)* | 0.62 (140) | 29 (168)* | NP | <-40 | 13 (75) | 8 (45) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim K45B | LLDPE | PET | 2400M ² (26,000 ft ²) | 1.01 (40) | NP | 4.2 (24) | <1% | .53 (120)* | 0.58 (130) | 30 (174)* | NP | <-40 | 17 (95) | 8.7 (50) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim R12BV | LLDPE | PET | 7600M ² (82,000 ft ²) | 0.28 (11.0) | NP | NA | NP | NP | 0.11 (25) | 10.5 (60)* | 690 (100)* | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim R12WB | LLDPE | PET | 7600M ² (82,000 ft ²) | 0.28 (11.0) | NP | NA | NP | NP | 0.11 (25) | 10.5 (60)* | 690 (100)* | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim R20WW | LLDPE | PET | 4400M ² (48,000 ft ²) | 0.48 (19.0) | NP | NA | NP | NP | 0.22 (50) | 14.4 (82)* | 1034 (150)* | <-40 | NP | NP | ILC, SIL, SIC, RP |
| Dura-Skrim R8BV | LLDPE | PET | 11000M ² (120,000 ft ²) | 0.18 (7.2) | NP | NA | NP | NP | 0.09 (20) | 9.6 (55)* | 550 (80)* | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim R8WB | LLDPE | PET | 11000M ² (120,000 ft ²) | 0.18 (7.2) | NP | NA | NP | NP | 0.09 (20) | 9.6 (55)* | 550 (80)* | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim KQ36B | Flexible PP | PET | 2800M ² (30,000 ft ²) | 0.81 (32) | NP | 3.5 (20) | <1% | .48 (108)* | 0.68 (152) | 27 (162)* | NP | <-40 | 13 (75) | 7.0 (40) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim KQ45B | Flexible PP | PET | 2400M ² (26,000 ft ²) | 1.02 (40) | NP | 3.8 (22) | <1% | .51 (115)* | 0.79 (177) | 30 (172)* | NP | <-40 | 18 (100) | 8.7 (50) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim K36BT1 | LLDPE Textured 1-Side | PET | 1200M ² (13,000 ft ²) | 0.76 (30) | NP | 5.4 (31) | <1% | .55 (124) | 0.66 (149) | 29 (165) | NP | <-40 | 13 (75) | 8 (45) | |
| Dura-Skrim K40BT2 | LLDPE Textured 2-Side | PET | 1200M ² (13,000 ft ²) | 0.91 (36) | NP | 5.4 (31) | <1% | .56 (125) | 0.72 (162) | 31 (175) | NP | <-40 | 13 (75) | 8 (45) | |
| Dura-Skrim K45BT1 | LLDPE Textured 1-Side | PET | 1200M ² (13,000 ft ²) | 1.02 (40) | NP | 5.6 (32) | <1% | .53 (120) | 0.61 (137) | 32 (184) | NP | <-40 | 17 (95) | 8.7 (50) | |
| Dura-Skrim K45BT2 | LLDPE Textured 2-Side | PET | 1200M ² (13,000 ft ²) | 1.02 (40) | NP | 5.6 (32) | <1% | .61 (137) | 0.65 (146) | 32 (181) | NP | <-40 | 17 (95) | 8.7 (50) | |

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| 6730 XR-5 | EIA | PET | 1,400 m ² 15,000 ft ² | 0.75 (30) | 1.2 app. | 2.63 (15) | 0.5 | NP | 70 | 2.46 (550) | 5520 | -35 | 2.46 (550) | 3.50 (20) | CL, SIL, SIC, LL, DL |
| 8130 XR-3 PW | EIA | PET | 1,400 m ² 15,000 ft ² | 0.75 (30) | 1.2 app. | 2.63 (15) | 0.5 | 350 | 125 | 2.46 (550) | 5520 | -35 | 2.46 (550) | 3.50 (20) | CL, SIL, SIC, DL |
| 8130 XR-5 | EIA | PET | 1,400 m ² 15,000 ft ² | 0.75 (30) | 1.2 app. | 2.63 (15) | 0.5 | 350 | 125 | 2.46 (550) | 5520 | -35 | 2.46 (550) | 3.50 (20) | CL, SIL, SIC, LL, DL |
| 8138 XR-5 | EIA | PET | 1,200 m ² 13,000 ft ² | 1.0 (40) | 1.2 app. | 2.63 (15) | 0.5 | 350 | 125 | 2.46 (550) | 5520 | -35 | 2.46 (550) | 3.50 (20) | CL, SIL, SIC, LL, DL |
| 8228 XR-3 | EIA | PET | 1,400 m ² 15,000 ft ² | 0.75 (30) | 1.2 app. | 2.10 (12) | 5 | 205 | 50 | 0.89 (200) | 2070 | -32 | 1.11 (250) | 1.75 (10) | CL, SIL, SIC, LC, LPL |
| 8142 XR-5 PW | EIA | PET | 1,200 SM / 13,000 SF | 1.13 (45) | 1.2 app. | 2.63 (15) | 0.5 | 350 | 125 | 2.46 (550) | 5520 (800) | -35 | 2.46 (550) | 3.50 (20) | SIC, SIL, CL |

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