



FOR MORE INFORMATION

Geosynthetics magazine has provided information on the geomembrane specification charts 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).

GMA
1801 County Rd B West
Roseville, MN 55113-4061 USA
+1 651 225 6956
fax +1 651 631 9334
jicurry@ifai.com
www.GMAnow.com

PUBLISHER'S NOTE

Geosynthetics magazine compiled all information included in the 2018 *Geosynthetics Specifier's Guide* from information submitted by firms in the geosynthetics industry. Companies provided specifications voluntarily, and specification 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 2018 *Geosynthetics Specifier's Guide* is intended as a guide, and *Geosynthetics* magazine and IFAI encourage readers to contact the companies listed for further information.

Manufacturers engineer these products to 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.

Manufacturers use several methods to bond 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 % | | | | | | |

AGRU America Inc. | www.agruamerica.com

| | | | | | | | | | | | | | | |
|----------------------------------|----------------------------|----------------------|----------|----------|------------|----|----------|--------|------------|-----------|-----------|-----|---------|--------------------------|
| Agru Drain Liner® | LLDPE Structured | 7.0/152.4 (23/500') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Cat 1/2 | CL, SIL, LL, LC, LPL, DL |
| Agru Grip Liner® | LLDPE Structured | 7.0/152.4 (23/500') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Cat 1/2 | CL, SIL, LL, LC, LPL, DL |
| Agru Microspike® Liner | LLDPE-T | 7.0/283.57 (23/710') | NA | 1.0 (40) | 0.939 max. | NA | 20 (112) | NA/400 | 0.22 (50) | 0.11 (25) | -60 (-83) | 2-3 | Cat 1/2 | CL, LC, TL, LPL, DL |
| Agru Microspike® Liner | LLDPE-T | 7.0/216.4 (23/505') | NA | 1.5 (60) | 0.939 max. | NA | 29 (168) | NA/400 | 0.31 (70) | 0.16 (36) | -60 (-83) | 2-3 | Cat 1/2 | CL, LC, TL, LPL, DL |
| Agru Microspike® Liner | LLDPE-T | 7.0/117.4 (23/385') | NA | 2.0 (80) | 0.939 max. | NA | 39 (224) | NA/400 | 0.40 (90) | 0.22 (50) | -60 (-83) | 2-3 | Cat 1/2 | CL, LC, TL, LPL, DL |
| Agru Smooth® Liner | LLDPE-S | 7.0/254.5 (23/835') | 1.0 (40) | NA | 0.939 max. | NA | 28 (160) | NA/800 | 0.26 (60) | 0.11 (25) | -60 (-83) | 2-3 | Cat 1/2 | CL, LC, TL, LPL, DL |
| Agru Smooth® Liner | LLDPE-S | 7.0/164.6 (23/540') | 1.5 (60) | NA | 0.939 max. | NA | 42 (240) | NA/800 | 0.40 (90) | 0.16 (37) | -60 (-83) | 2-3 | Cat 1/2 | CL, LC, TL, LPL, DL |
| Agru Smooth® Liner | LLDPE-S | 7.0/126.5 (23/415') | 2.0 (80) | NA | 0.939 max. | NA | 56 (320) | NA/800 | 0.53 (120) | 0.21 (48) | -60 (-83) | 2-3 | Cat 1/2 | CL, LC, TL, LPL, DL |
| Agru Super Gripnet® Liner | LLDPE Structured | 7.0/152.4 (23/500') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Cat 1/2 | CL, SIL, LL, LC, LPL, DL |
| ClosureTurf® | LLDPE O/C Structured -Turf | 7.0/152.4 (23/500') | NA | 1.5 (60) | 0.939 max. | NA | 22 (126) | NA/300 | 0.31 (70) | 0.18 (40) | -60 (-83) | 2-3 | Cat 1/2 | CL, SIL, LL, LC, LPL, DL |

Atarfil S.L. | www.atarfil.com

| | | | | | | | | | | | | | | |
|--|-------|---|--------------------------------|--------------------------------|---------|----|--------|------|----------|-----------|-----|-------|-----|-----------------|
| ATARFIL LLD smooth | LLDPE | width: 6.0 (19.7)/ 6.3 (20.6)/7.5 (24.6) length: 70 (229) to 405 (1332) | 0.5 to 4.0 mm (20 to 160 mils) | NA | ≤ 0.940 | NA | 13-104 | ≥700 | 0.15-1.2 | 0.05-0.39 | -75 | 2-2.5 | 1-2 | CL, SIL, DP, RP |
| ATARFIL LLDS colored smooth | LLDPE | width: 6.0 (19.7)/ 6.3 (20.6)/7.5 (24.6) length: 70 (229) to 405 (1332) | 0.5 to 4.0 mm (20 to 160 mils) | NA | ≤ 0.940 | NA | 13-104 | ≥700 | 0.15-1.2 | 0.05-0.39 | -75 | 2-2.5 | 1-2 | CL, SIL, DP, RP |
| ATARFIL LLDE conductive | LLDPE | width: 6.0 (19.7)/ 6.3 (20.6)/7.5 (24.6) length: 70 (229) to 405 (1332) | 0.5 to 4.0 mm (20 to 160 mils) | NA | ≤ 0.940 | NA | 13-104 | ≥700 | 0.15-1.2 | 0.05-0.39 | -75 | ≥2 | 1-2 | CL, SIL, DP, RP |
| ATARFIL LLD TM/ TMT® (single/ double textured structured) asperity 0.9mm / 35mils | LLDPE | width: 6.0 (19.7) length: 90 (295) to 263 (864) | NA | 0.5 to 4.0 mm (20 to 160 mils) | ≤ 0.940 | NA | 13-104 | ≥700 | 0.15-1.2 | 0.05-0.39 | -75 | 2-2.5 | 1-2 | LC |
| ATARFIL LLD TM/ TMT® (single/ double textured structured) asperity 0.5mm / 28 mils | LLDPE | width: 6.0 (19.7)/ 6.3 (20.6)/7.5 (24.6) length: 90 (295) to 200m | NA | 0.5 to 4.0 mm (20 to 160 mils) | ≤ 0.940 | NA | 13-104 | ≥700 | 0.15-1.2 | 0.05-0.39 | -75 | 2-2.5 | 1-2 | LC |
| ATARFIL LLD TM/TMT® S colored (single/ double textured structured) asperity 0.5mm / 28 mils | LLDPE | width: 6.0 (19.7)/ 6.3 (20.6)/7.5 (24.6) length: 90 (295) to 200 (656) | 0.5 to 4.0 mm (20 to 160 mils) | NA | ≤ 0.940 | NA | 13-104 | ≥700 | 0.15-1.2 | 0.05-0.39 | -75 | 2-2.5 | 1-2 | LC |

♦Tensile and Puncture properties: values obtained from the smooth part of the geomembrane

- [1] CX = Coextruded
- CX-T = Coextruded, textured
- EIA = Ethylene interpolymer 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
- LPL = Leach pad liner
- LC = Landfill cover
- TL = Tunnel liner
- RP = Reserve pit
- DL = Dam liner
- SIC = Surface impoundment cover
- LL = Landfill liner
- DP = Decorative pond
- SIL = Surface impoundment liner
- SC = Secondary Containment

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

| 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 % | | | | | | |
| Atarfil S.L. www.atarfil.com | | | | | | | | | | | | | | |
| ATARFLEX smooth | VLDPE | width: 2.0 (6.5) length: 20 (65.6) | 0.75 to 2.0 mm (30 to 80mils) | NA | ≤ 0.920 | NA | 12-36 | ≥700 | 0.25-0.75 | 0.05-0.16 | -70 | 2-2.5 | 1-2 | SIL, TL |
| ATARFLEX TM/ TMT[®] (single/double textured structured) asperity 0.9mm | VLDPE | width: 6.0 (19.7) length: 90 (295) to 200 (656) | NA | 0.75-2.0 mm (30 to 80 mils) | ≤ 0.920 | NA | 12-36 | ≥700 | 0.25-0.75 | 0.05-0.16 | -70 | 2-2.5 | 1-2 | SIL |
| ATARFLEX S colored smooth | VLDPE | width: 2.0 (6.5) length: 20 (65.6) to 40 (131) | NA | NA | ≤ 0.920 | NA | 12-36 | ≥700 | 0.25-0.75 | 0.05-0.16 | -70 | 2-2.5 | 1-2 | SIL, TL |
| ATARFLEX TW tunnels | VLDPE | width: 2.0 (6.5) length: 20 (65.6) to 40 (131) | 1.5 to 3.0 (60 to 120 mils) | NA | ≤ 0.920 | NA | 16-33 | ≥700 | 0.33-1.0 | 0.06-0.13 | -70 | NA | NA | TL |
| ATARTEC Roofing | TPO/ FPO | width: 2.0 (6.5) length: 20 (65.6) to 40 (131) | 0.75 to 2.5 (30 to 100 mils) | NA | NP | NA | 8.3-41.5 | NA/≥700 | NP | EN12310-2=54-270 | -70 | 2-2.5 | 1-2 | roofing |
| ATARTEC RSV | TPO/ FPO | PP/PES | width: 2.00 (6.5) Length: 15-25 (49-82) | 1.2/ 1.5/ 2.0 mm (47/ 60/ 80 mil) | | NP | ± 1.5 | NA | NA | NA | NA | -40 | NA | NA |

↳Tensile and Puncture properties: values obtained from the smooth part of the geomembrane

Engineered Polymer Technologies (EPT) | www.epttech.com

| | | | | | | | | | | | | | | |
|-------------------------|---|-------------------|-----------------------------|----|----|----|----|----|----|----|-----|----|----|--------------------------|
| EPT Xtrm Ply TPU | TPU (ester or ether based polyurethane) | width 60" to 120" | 20 to 120 mils ⁺ | NA | NA | NA | NA | NA | NA | NA | -40 | NA | NA | SIL, SIC, SR, SC, LC, TL |
|-------------------------|---|-------------------|-----------------------------|----|----|----|----|----|----|----|-----|----|----|--------------------------|

↳Data listed is min. value for 20 mil product.

GSE Environmental | www.gseworld.com

| | | | | | | | | | | | | | | |
|--|------------|---------------------|----------|----------|-------|----|----------|--------|-------------|------------|-------------|-----|---------|-----|
| GSE Ultraflex Smooth | LLDPE | 6.86/265 (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 | 6.86/171 (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 Textured | LLDPE-CX-T | 6.86/213 (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 | 6.86/158 (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 |
| High Performance GSE Ultraflex Smooth | LLDPE | 6.86/265 (22.5/870) | 1.0 (40) | NA | 0.939 | NA | 29 (170) | NA/900 | 0.311 (70) | 0.100 (22) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| High Performance GSE Ultraflex Smooth | LLDPE | 6.86/171 (22.5/560) | 1.5 (60) | NA | 0.939 | NA | 42 (240) | NA/900 | 0.444 (100) | 0.150 (33) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| High Performance GSE Ultraflex Textured | LLDPE-CX-T | 6.86/158 (22.5/520) | NA | 1.5 (60) | 0.939 | NA | 29 (168) | NA/500 | 0.422 (95) | 0.169 (38) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |
| High Performance GSE Ultraflex Textured | LLDPE-CX-T | 6.86/122 (22.5/400) | NA | 2.0 (80) | 0.939 | NA | 39 (224) | NA/500 | 0.556 (125) | 0.222 (50) | <-70 (<-94) | 2-3 | 1, 2, 3 | all |

Note: All of GSE Geomembranes are available in a variety of thicknesses and with black, white or green surface layers.

- [1] CX = Coextruded
 CX-T = Coextruded, textured
 EIA = Ethylene interpolymers 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
 TL = Tunnel liner DP = Decorative pond
 RP = Reserve pit SIL = Surface impoundment liner
 SC = Secondary Containment
 NP = Not provided by manufacturer
 NA = Not applicable, per manufacturer

| 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 % | | | | | | |
| HUITEX www.huitex.com | | | | | | | | | | | | | | |
| HUITEX Both OIT Series | LLDPE CX | 7(23)/76(249) ~ 420(1378) | 0.50(20) ~ 2.50(100) | 0.50(20) ~ 2.50(100) | <0.939 | NA | 9(51) ~ 66(372) | NA/250 ~ 800 | 0.120(26) ~ 0.620(136) | 0.050(11) ~ 0.250(55) | -70(-94) | 2.0~3.0 | cat.1/2 | all |
| HUITEX Colored Series | LLDPE | 7(23)/84(276) ~ 420(1378) | 0.50(20) ~ 2.50(100) | 0.50(20) ~ 2.50(100) | <0.939 | NA | 14(79) ~ 66(372) | NA/250 ~ 800 | 0.120(26) ~ 0.620(136) | 0.050(11) ~ 0.250(55) | -70(-94) | 2.0~3.0 black layer | cat.1/2 black layer | all |
| Layfield Environmental Containment www.layfieldgroup.com | | | | | | | | | | | | | | |
| Enviro Liner 6030x | O/C | 3.75/457 (12.3/1250) | 0.75 (30) | NA | ≤ 0.939 | NA | 25 (141) | 1000% | 0.236 (53) | NA | -70 (-90) | ≥2.0 | Pass | all |
| Enviro Liner 6040x | O/C | 6.8/305 (22.5/1000) | 1.0 (40) | NA | ≤ 0.939 | NA | 31 (180) | 1000% | 0.298 (67) | NA | -70 (-90) | ≥2.0 | Pass | all |
| Enviro Liner 6050x | O/C | 6.8/244 (22.5/800) | 1.25 (50) | NA | ≤ 0.939 | NA | 38 (220) | 1000% | 0.33 (75) | NA | -70 (-90) | ≥2.0 | Pass | all |
| Enviro Liner 6060x | O/C | 6.8/158 (22.5/520) | 1.50 (60) | NA | ≤ 0.939 | NA | 44 (255) | 1000% | 0.40 (90) | NA | -70 (-90) | ≥2.0 | Pass | all |
| Enviro Liner 6080x | O/C | 6.8/122 (22.5/400) | 2.0 (80) | NA | ≤ 0.939 | NA | 53 (304) | 800% | 0.50 (112) | NA | -70 (-90) | ≥2.0 | Pass | all |
| Enviro Liner 6040 Textured | O/C | 6.8/237 (22.5/780) | 1.0 (40) | 0.96 (38) | ≤ 0.939 | NA | 13 (76) | 350% | 0.236 (53) | 0.98 (22) | -70 (-90) | ≥2.00 | Pass | all |
| Enviro Liner 6060 Textured | O/C | 6.8/134 (22.5/440) | 1.50 (60) | 1.45 (57) | ≤ 0.939 | NA | 20 (114) | 350% | 0.355 (80) | 0.147 (33) | -70 (-90) | ≥2.00 | Pass | all |
| Enviro Liner 7040 | O/C | 6.8/305 (22.5/1000) | 1.0 (40) | NA | NA | NA | 29 (164) | 700% | 0.267 (60) | 0.10 (22) | -70 (-90) | ≥2.00 | Pass | all |
| Enviro Liner 7050 | O/C | 6.8/244 (22.5/800) | 1.25 (50) | NA | NA | NA | 35 (200) | 700% | 0.334 (75) | 0.12 (27) | -70 (-90) | ≥2.00 | Pass | all |
| Enviro Liner 7060 | O/C | 6.8/158 (22.5/520) | 1.5 (60) | NA | NA | NA | 42 (240) | 700% | 0.40 (90) | 0.15 (33) | -70 (-90) | ≥2.00 | Pass | all |
| HAZGARD 635FR | O/C | 3.14/305 (10.3/1000) | 0.88 (35) | NA | NA | NA | 22.8 (130) | 700% | 0.218 (49) | NA | -70 (-90) | Red | NA | SC (Secondary Containment) |

- [1] CX = Coextruded
- CX-T = Coextruded, textured
- EIA = Ethylene interpolymer 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
- LPL = Leach pad liner
- LC = Landfill cover
- TL = Tunnel liner
- RP = Reserve pit
- DL = Dam liner
- SIC = Surface impoundment cover
- LL = Landfill liner
- DP = Decorative pond
- SIL = Surface impoundment liner
- SC = Secondary Containment

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

| 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 % | | | | | | |

Raven Engineered Films | www.ravengeo.com

| | | | | | | | | | | | | | | |
|---|------------------|--------------------------------|-----------|-----------|--------|----|-----------|-----|-----------|-----------|-----------|---|----------|--|
| HydraFlex Ultra HU20B - Meets GRI-GM17 | LLDPE | 4600 (50,000 ft ²) | 0.50 (20) | NA | ≤0.939 | NA | 24 (136) | 800 | 0.22 (49) | 0.06 (13) | -70 (-57) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| HydraFlex Ultra HU30B - Meets GRI-GM17 | LLDPE | 3500 (35,000 ft ²) | 0.75 (30) | NA | ≤0.939 | NA | 30 (170) | 800 | 0.28 (62) | 0.08 (17) | -70 (-57) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| HydraFlex Ultra HU40B - Meets GRI-GM17 | LLDPE | 2300 (25,000 ft ²) | 1.00 (40) | NA | ≤0.939 | NA | 36 (208) | 800 | 0.34 (77) | 0.10 (22) | -70 (-57) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| HydraFlex HT30 | LLDPE (textured) | 3500 (35,000 ft ²) | NA | 0.64 (25) | ≤0.939 | NA | 11 (60) | 300 | 0.13 (30) | 0.05 (12) | -70 (-57) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| HydraFlex HT40 | LLDPE (textured) | 2300 (25,000 ft ²) | NA | 0.89 (35) | ≤0.939 | NA | 12 (70) | 300 | 0.18 (40) | 0.08 (16) | -70 (-57) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| HydraFlex V30B | LLDPE | 2300 (25,000 ft ²) | 0.75 (30) | NA | ≤0.886 | NA | 16 (90) | 700 | 0.18 (40) | 0.04 (9) | -70 (-57) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| Absolute Barrier Y30BAC | LLDPE/EVOH | 3500 (35,000 ft ²) | 0.75 (30) | NA | ≤0.924 | NA | 14.9 (85) | 300 | 0.33 (71) | 0.09 (19) | -40 (-40) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| Absolute Barrier Y40BAC | LLDPE/EVOH | 2300 (25,000 ft ²) | 1.00 (40) | NA | ≤0.924 | NA | 16 (90) | 350 | 0.33 (75) | 0.10 (22) | -40 (-40) | 2 | Note [4] | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |

Solmax International Inc. | www.solmax.com

| | | | | | | | | | | | | | | |
|--|----------|-------------------------------------|-------------------|----|--------|----|-----------------|---------|--------------------|--------------------|------------|-----|--------|----------------|
| White Reflective LLDPE Series (Smooth-Textured) | LLDPE-CX | 6.71-8.0/97-427 (22-26.2/320-1400) | 0.5-3.0 (20-120) | NA | <0.939 | NA | 9-66 (52-377) | 250-800 | 0.12-0.62 (28-140) | 0.05-0.25 (11-56) | -75 (-103) | 2-3 | 1 or 2 | DL, LC, TL, DP |
| Conductive LLDPE Series (Smooth-Textured) | LLDPE-CX | 6.71-7.5/97-427 (22-24.6/320-1400) | 0.5-3.0 (20-120) | NA | <0.939 | NA | 9-66 (52-377) | 250-800 | 0.12-0.62 (28-140) | 0.05-0.25 (11-56) | -75 (-103) | 2-3 | 1 or 2 | DL, LC, TL, DP |
| Premium LLDPE Series (Smooth-Textured) | LLDPE-CX | 6.71-8.0/97-237.7 (22-26.2/320-780) | 1.0-2.5 (40-100) | NA | <0.939 | NA | 20-66 (115-380) | 500-900 | 0.10-0.25 (22-55) | 0.29-0.69 (65-155) | -77 (-106) | 2-3 | 1 or 2 | DL, LC, TL, DP |
| Enviromax Series (Smooth-Textured) | LLDPE-CX | 6.71-8.0/105-427 (22-26.2/400-1400) | 0.5-2.0 (20-80) | NA | <0.939 | NA | NA | 800 | 0.12-0.62 (28-140) | 0.05-0.25 (11-56) | -75 (-103) | 2-3 | 1 or 2 | DL, LC, TL, DP |
| F3 Series (Smooth) | LLDPE-CX | 6.8/237.7-304.8 (22.3/780-1000) | 0.75-1.00 (30-40) | NA | <0.939 | NA | 20-23 (114/131) | 800 | 0.42-0.48 (42-48) | 0.16-0.19 (70-85) | -75 (-103) | 2-3 | 1 or 2 | DL, LC, TL, DP |

Based on a gauge length of 2"

- [1] CX = Coextruded
 CX-T = Coextruded, textured
 EIA = Ethylene interpolymers 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
 TL = Tunnel liner DP = Decorative pond
 RP = Reserve pit SIL = Surface impoundment liner
 RSC = Rain Shed Cover SC = Secondary Containment
 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 % | | | | | | | | | | | |

AGRU America Inc. | www.agruamerica.com

| | | | | | | | | | | | | | | | | | | | |
|----------------------------------|-----------------|--------------------|-----------|------|----------|----------|----|-----|------------|-----------|-----|---------|------|-----|-----|----|----|----|---------------------------------------|
| Agru Drain Liner® | HDPE Structured | 7.0/152.4 (23/500) | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 300 | 0.42 (95) | 0.18 (40) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, LL, LC, LPL, DL |
| Agru Grip Liner® | HDPE Structured | 7.0/152.4 (23/500) | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 300 | 0.42 (95) | 0.18 (40) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, LL, LC, LPL, DL |
| Agru Smooth® Liner | HDPE-S | 7.0/317 (23/835) | 1.0 (40) | 0.94 | 15 (88) | 28 (160) | 13 | 700 | 0.36 (80) | 0.13 (30) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Smooth® Liner | HDPE-S | 7.0/164.6 (23/540) | 1.5 (60) | 0.94 | 23 (132) | 42 (240) | 13 | 700 | 0.53 (120) | 0.20 (45) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Smooth® Liner | HDPE-S | 7.0/102.1 (23/415) | 2.0 (80) | 0.94 | 31 (176) | 56 (320) | 13 | 700 | 0.71 (160) | 0.27 (60) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Micro Spike® Liner | HDPE-T | 7.0/253.4 (23/710) | 1.0 (40) | 0.94 | 15 (88) | 15 (88) | 13 | 350 | 0.40 (90) | 0.13 (30) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Micro Spike® Liner | HDPE-T | 7.0/216.4 (23/505) | 1.5 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 350 | 0.53 (120) | 0.20 (45) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Micro Spike® Liner | HDPE-T | 7.0/117.4 (23/385) | 20 (80) | 0.94 | 31 (176) | 31 (176) | 13 | 350 | 0.66 (150) | 0.27 (60) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, SIC, LL, LC, LPL, TL, DL, DP |
| Agru Super Gripnet® Liner | HDPE Structured | 7.0/152.4 (23/500) | 1.50 (60) | 0.94 | 23 (132) | 23 (132) | 13 | 200 | 0.40 (90) | 0.18 (40) | 2-3 | Cat 1/2 | 1000 | 160 | 800 | 55 | 80 | 80 | CL, SIL, LL, LC, LPL, DL |

[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 | 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 % | | | | | | | | | | | |

Atarfil S.L. | www.atarfil.com

| | | | | | | | | | | | | | | | | | | | |
|---|------|--|--------------------------------|---------|--------|--------|------|-------|-----------|-----------|-------|-----|-------|-----|------|----|----|----|--------------------------|
| ATARFIL HD smooth | HDPE | width: 6.0 (19.7)/ 6.3 (20.6)/ 7.5 (24.6) length: 70 (229) to 405 (1332) | 0.5 to 4.0 mm (20 to 160 mils) | ≥ 0,942 | 8.0-64 | 10-108 | > 12 | ≥ 700 | 0.16-1.28 | 0.06-0.54 | 2-2.5 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | CL, SIL, LL, CL, LPL, RP |
| ATARFIL HDS colored smooth | HDPE | width: 6.0 (19.7)/ 6.3 (20.6)/ 7.5 (24.6) length: 70 (229) to 405 (1332) | 0.5 to 4.0 mm (20 to 160 mils) | ≥ 0,942 | 8.0-64 | 10-108 | > 12 | ≥ 700 | 0.16-1.28 | 0.06-0.54 | 2-2.5 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | DP, DL, RP, CL, SIL |
| ATARFIL HDE conductive | HDPE | width: 6.0 (19.7)/ 6.3 (20.6)/ 7.5 (24.6) length: 70 (229) to 405 (1332) | 0.5 to 4.0 mm (20 to 160 mils) | ≥ 0,942 | 8.0-64 | 10-108 | > 12 | ≥ 700 | 0.16-1.28 | 0.06-0.54 | ≥2 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | CL, SIL, LL, CL, LPL, RP |
| ATARFIL TM-TMT [®] (single/double textured structured) asperity 0.9mm / 35mils | HDPE | width: 6.0 (19.7) length: 90 (295) to 263 (864) | 0.5 to 4.0 mm (20 to 160 mils) | ≥ 0,942 | 8.0-64 | 10-108 | > 12 | ≥ 700 | 0.16-1.28 | 0.06-0.54 | 2-2.5 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | LC |
| ATARFIL TM-TMT [®] (single/double textured structured) asperity 0.5mm / 28mils | HDPE | width: 6.0 (19.7)/ 6.3 (20.6)/ 7.5 (24.6) length: 90 (295) to 200 (656) | 0.5 to 4.0 mm (20 to 160 mils) | ≥ 0,942 | 8.0-64 | 10-108 | > 12 | ≥ 700 | 0.16-1.28 | 0.06-0.54 | 2-2.5 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | LC |
| ATARFIL TM-TMT [®] S colored (single/double textured structured) asperity 0.5mm / 28mils | HDPE | width: 6.0 (19.7)/ 6.3 (20.6)/ 7.5 (24.6) length: 90 (295) to 200 (656) | 0.5 to 4.0 mm (20 to 160 mils) | ≥ 0,942 | 8.0-64 | 10-108 | > 12 | ≥ 700 | 0.16-1.28 | 0.06-0.54 | 2-2.5 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | LC |
| ATARLOCK CPL | HDPE | width: 2.0 (6.5) length: 20 (65.6) | 2.0 to 5.0 mm (80 to 200 mils) | ≥ 0,942 | 16-80 | NA | NA | ≥ 400 | NA | NA | 2-2.5 | 1,2 | ≥3000 | 100 | ≥400 | 55 | 80 | 70 | concrete protection |

↳ Tensile and Puncture properties and Stress Crack Resistance: values obtained from the smooth part of the 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 LC = 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 | High Pressure OIT (min. age.) % retained after 1600 hrs [10] | | |
| | | | | | Yield Stress kN/m (lb/in) | Break Stress kN/m (lb/in) | Yield Elongation % | Break Elongation % | | | | | | | | | | | |

| GSE Environmental www.gseworld.com | | | | | | | | | | | | | | | | | | | |
|--------------------------------------|---------|---------------------|----------|-------|----------|----------|----|-----|-------------|------------|-----|---------|------|-----|-----|-----|----|----|-----|
| GSE HD Leak Location Liner Smooth | HD-CX-S | 6.86/171 (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 Leak Location Liner Smooth | HD-CX-S | 6.86/131 (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 Leak Location Liner Textured | HD-CX-T | 6.86/158 (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 Leak Location Liner Textured | HD-CX-T | 6.86/122 (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 |
| GSE HD Smooth | HD-S | 6.86/265 (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 | 6.86/171 (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 Smooth | HD-S | 6.86/131 (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 Textured | HD-C-T | 6.86/213 (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 | 6.86/158 (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 Textured | HD-C-T | 6.86/122 (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 |
| High Performance GSE HD Smooth | CX-S | 6.86/171 (22.5/560) | 1.5 (60) | 0.940 | 23 (132) | 42 (243) | 13 | 800 | 0.556 (125) | 0.187 (42) | 2-3 | 1, 2, 3 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| High Performance GSE HD Smooth | CX-S | 6.86/131 (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 |
| High Performance GSE HD Textured | CX-T | 6.86/158 (22.5/520) | 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 |
| High Performance GSE HD Textured | CX-T | 6.86/122 (22.5/400) | 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 |

Note: All of GSE Geomembranes are available in a variety of thicknesses and with black, white or green surface layers.

- [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 | DL = Dam liner |
| SIL = Surface impoundment liner | LPL = Leach pad liner |
| LL = Landfill liner | LC = Landfill cover |
| DP = Decorative pond | TL = Tunnel liner |
| NP = Not provided by manufacturer | RP = Reserve pit |
| 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 | High Pressure OIT | ASTM D3895 % retained after 90 days | ASTM D5885 % retained after 90 days | High Pressure OIT (min. age.) % retained after 1600 hrs [10] | | | |

HUITEX | www.huitex.com

| | | | | | | | | | | | | | | | | | | | |
|-----------------------------------|---------|---|----------------------|-------|-------------------|--------------------|----|-----------|-------------------------|------------------------|-----------------------|---------------------|-----|-----------------|-----------------|----------------|----------------|----------------|---------------------|
| HUITEX Both OIT Series | HDPE CX | 7(23) ~ 8(26)/65(213) ~ 420(1378) | 0.50(20) ~ 3.00(120) | 0.940 | 7(40) ~ 44(251) | 13(74) ~ 80(457) | 13 | 700 | 0.160(36) ~ 0.960(216) | 0.06(13) ~ 0.37(83) | 2.0 ~ 3.0 | cat.1/2 | 500 | 100 | 400 | 55 | 80 | 50 | all |
| HUITEX Colored Series | HDPE CX | 7(23) ~ 8(26)/70(230) ~ 420(1378) | 0.50(20) ~ 3.00(120) | 0.940 | 7(40) ~ 44(251) | 13(74) ~ 80(457) | 13 | 100 ~ 700 | 0.160(36) ~ 0.960(216) | 0.06(13) ~ 0.37(83) | 2.0 ~ 3.0 black layer | cat.1/2 black layer | 500 | 100 black layer | 400 black layer | 55 black layer | 80 black layer | 50 black layer | all |
| HUITEX K-Linear CPL series | HDPE | 2.5(8.21) ~ 3.0(9.75)/60(197) ~ 70(230) | 2.00(80) ~ 5.00(200) | 0.940 | 30(170) ~ 75(422) | 50(280) ~ 125(700) | 13 | 500 | 0.730(164) ~ 1.800(405) | 0.275(60) ~ 0.678(150) | 2.0 ~ 3.0 | cat.1/2 | 500 | 100 | 400 | N/A | N/A | N/A | Concrete Protection |

Layfield Environmental Containment | www.layfieldgroup.com

| | | | | | | | | | | | | | | | | | | | |
|----------------------------------|------|----------------------------|-----------|--------|----------|----------|-----|------|-------------|------------|--------|----------|------|-----|-----|-----|-----|-----|-------------------------------------|
| Layfield HDPE 60 | HDPE | 6.86/158.5 m (22.5/520 ft) | 1.5 (60) | ≥ 0.94 | 22 (126) | 40 (228) | 12% | 700% | 0.48 (108) | 0.187 (42) | ≥ 2.0% | Note [5] | 500 | 100 | 400 | 55% | 80% | 50% | all |
| Layfield HDPE 80 | HDPE | 6.86/122 m (22.5/400 ft) | 2.0 (80) | ≥ 0.94 | 29 (168) | 53 (304) | 12% | 700% | 0.64 (144) | 0.249 (56) | ≥ 2.0% | Note [5] | 500 | 100 | 400 | 55% | 80% | 50% | all |
| Layfield HDPE 60 Textured | HDPE | 6.86/171 m (22.5/560 ft) | 1.45 (57) | ≥ 0.94 | 22 (126) | 16 (90) | 12% | 100% | 0.4 (90) | 0.187 (42) | ≥ 2.0% | Note [5] | 500 | 100 | 400 | 55% | 80% | 50% | all |
| Layfield HDPE 80 Textured | HDPE | 6.86/134 m (22.5/440 ft) | 1.90 (76) | ≥ 0.94 | 29 (168) | 21 (120) | 12% | 100% | 0.534 (120) | 0.249 (56) | ≥ 2.0% | Note [5] | 500 | 100 | 400 | 55% | 80% | 50% | all |
| HEATGARD PW 45 | HDPE | 6.86/158.5 m (22.5/520 ft) | 1.5 (60) | ≥ 0.94 | 20 (114) | 30 (171) | 13% | 600% | 0.48 (108) | 0.187 (42) | ≥ 2.0% | CAT1 | 1000 | 100 | 400 | 55% | 80% | 50% | Long Term Potable Water Containment |
| HEATGARD PW 60 | HDPE | 6.86/158.5 m (22.5/520 ft) | 1.5 (60) | ≥ 0.94 | 27 (152) | 40 (228) | 13% | 600% | 0.64 (144) | 0.249 (56) | ≥ 2.0% | CAT1 | 1000 | 100 | 400 | 55% | 80% | 50% | Long Term Potable Water Containment |
| HEATGARD High Temp 60 | HDPE | 6.86/158.5 m (22.5/520 ft) | 1.5 (60) | ≥ 0.94 | 27 (152) | 40 (228) | 13% | 600% | 0.4 (90) | 0.187 (42) | ≥ 2.0% | CAT1 | 1000 | 100 | 400 | 55% | 80% | 50% | High Temperature Containment |
| HEATGARD High Temp 80 | HDPE | 6.86/122 m (22.5/400 ft) | 2.0 (80) | ≥ 0.94 | 36 (204) | 53 (304) | 13% | 600% | 0.534 (120) | 0.249 (56) | ≥ 2.0% | CAT1 | 1000 | 100 | 400 | 55% | 80% | 50% | High Temperature Containment |

[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 LC = 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 | Standard OIT ASTM D3895 % retained after 90 days | High Pressure OIT ASTM D5885 % retained after 90 days | | | |
| | | | | | Yield Stress kN/m (lb/in) | Break Stress kN/m (lb/in) | Yield Elongation % | Break Elongation % | | | | | | | | | | | | |

Raven Engineered Films | www.ravengeo.com

| | | | | | | | | | | | | | | | | | | |
|--------------------------------|------------|--|-----------|-------|----|--------------|----|-----|------------|-----------|---|----------|---------|---------|---------|--|--|--|
| Absolute Barrier X40BAL | HDPE/ EVOH | 1600 (19,200 ft ²) LF Mill Rolls | 1.00 (40) | ≥0.94 | NA | 19.1 (109) | NA | 411 | 0.41 (91) | 0.14 (32) | 2 | Note [4] | 500 hrs | 100 min | 400 min | | | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| Absolute Barrier X60BAL | HDPE/ EVOH | 1200 (13,600 ft ²) LF Mill Rolls | 1.50 (60) | ≥0.94 | NA | 29.2 (166.5) | NA | 404 | 0.63 (138) | 0.22 (49) | 2 | Note [4] | 500 hrs | 100 min | 400 min | | | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |
| Absolute Barrier X60BCS | HDPE/ EVOH | 1200 (13,600 ft ²) LF Mill Rolls | 1.50 (60) | ≥0.94 | NA | 22.1 (126) | NA | 400 | 0.40 (90) | 0.19 (42) | 2 | Note [4] | 500 hrs | 100 min | 400 min | | | CL, LPL, LC, TL, RP, SIC, DP, SIL, RSC |

Solmax International Inc. | www.solmax.com

| | | | | | | | | | | | | | | | | | | | |
|---|---------|--------------------------------------|-------------------|-------|-----------------|-----------------|----|---------|---------------------|-------------------|-----|--------|------|-----|------|-----|----|----|---------------------|
| White Reflective HDPE Series (Smooth-Textured) | HDPE-CX | 6.71-8.0/81-427 (22.0-26.2/265-1400) | 0.5-3.0 (20-120) | 0.940 | 7-44 (40-251) | 11-80 (66-457) | 13 | 150-700 | 0.16-0.96 (36-216) | 0.06-0.37 (13-83) | 2-3 | 1 or 2 | 500 | 100 | 400 | N/A | 80 | 50 | all |
| Conductive HDPE Series (Smooth-Textured) | HDPE-CX | 6.71-7.5/81-427 (22.0-26.2/265-1400) | 1.5-3.0 (60-120) | 0.940 | 23-44 (132-251) | 43-80 (243-457) | 13 | 150-700 | 0.53-0.96 (120-216) | 0.18-0.37 (42-83) | 2-3 | 1 or 2 | 500 | 100 | 400 | N/A | 80 | 50 | all |
| Premium HDPE Series (Smooth-Textured) | HDPE-CX | 6.71-8.0/81-427 (22.0-26.2/265-1400) | 1.5-3.0 (60-120) | 0.940 | 23-44 (132-251) | 43-80 (243-457) | 13 | 200-750 | 0.55-0.96 (125-216) | 0.18-0.37 (42-83) | 2-3 | 1 or 2 | 1000 | 160 | 800 | N/A | 80 | 80 | all |
| BioCoverPro 2 Series (Smooth) | HDPE-CX | 8.0/85-210 (26.2/279-689) | 1.00-2.5 (40-100) | 0.940 | 15-37 (84-212) | 27-71 (152-410) | 12 | 750 | 0.38-0.87 (85-195) | 0.13-0.32 (2873) | 2-3 | 1 or 2 | 1500 | 200 | 1000 | N/A | 90 | 85 | Inflated Cover |
| Goliath Series (Smooth-Textured) | HDPE-CX | 6.71-8.0/81-427 (22.0-26.2/265-1400) | 1.5-3.0 (60-120) | 0.940 | 23-44 (132-251) | 43-80 (243-457) | 13 | 200-750 | 0.55-0.96 (125-216) | 0.18-0.37 (42-83) | 2-3 | 1 or 2 | 1500 | 200 | 1000 | N/A | 90 | 85 | Chemical processing |

[1] HDPE = High density polyethylene
CX = Coextruded
T = Textured
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. 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 smooth | PP | 40 m ² (430 ft ²) - width: 2.0 m (6.5 ft) | 1.00-2.50 mm (40-100 mils) | ≥ 0.88 | ±1.50 | 0.13-0.32 | 0.06-0.15 | NA | 12-30 | NA | ≥ 500 | -40 | NP | NP | 2-2.5 | CL, SIC, LPL, LC, RP, SIL |
| ATARPOL S colored smooth | PP | 40 m ² (430 ft ²), width: 2.0 m (6.5 ft) | 1.00-2.50 mm (40-100 mils) | ≥ 0.88 | ±1.50 | 0.13-0.32 | 0.06-0.15 | NA | 12-30 | NA | ≥ 500 | -40 | NP | NP | 2-2.5 | CL, SIL, SIC, DP, RP |
| ATARPOL TM/TMT [◊] (single/double textured structured) asperity 0.9 /35mils | PP | 540-1260 m ² (5812-13562 ft ²), width: 6 m (19.7 ft) | 1.0/ 1.5/ 2.0 mm (40/60/80 mils) | ≥ 0.88 | ±1.50 | 0.13-0.26 | 0.06-0.12 | NA | 12-30 | NA | ≥ 700 | -40 | NP | NP | 2-2.5 | SIC, LPL, LC, RP, SIL |
| ATARPOL TM/TMT [◊] (single/double textured structured) asperity 0.5mm /28 mils | PP | 540-1260 m ² (5812-13562 ft ²), width: 6 m (19.7 ft) | 1.0/ 1.5/ 2.0 mm (40/60/80 mils) | ≥ 0.88 | ±1.50 | 0.13-0.26 | 0.06-0.12 | NA | 12-30 | NA | ≥ 700 | -40 | NP | NP | 2-2.5 | SIC, LPL, LC, RP, SIL |
| ◊Tensile and Puncture properties: values obtained from the smooth part of the geomembrane | | | | | | | | | | | | | | | | |
| 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 |
| Engineered Polymer Technologies (EPT) www.epttech.com | | | | | | | | | | | | | | | | |
| EPT Xtrm Ply fPP | flexible PP | width: 60-120" | 20 to 120 mils [◊] | 1.2 | 0.5 | 10 lb [◊] | 9 lb [◊] | NA | 70 [◊] | NA | 700 | -40 | 25 [◊] | 15 [◊] | >2.5 | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| EPT Xtrm Ply rPP | TPO-PP ^{◊◊} | PET 60-120" | 20 to 120 mils [◊] | 1.2 | 0.9 | 15 [◊] | 1 | 350 [◊] | 70 [◊] | 200 [◊] | 400 [◊] | -40 | NP | NP | | CL, SIL, SIC, LL, DL, LPL, LC, TL |
| ◊Data listed is min. value for 20 mil product ◊◊Data listed is min. value for 30 mil product | | | | | | | | | | | | | | | | |
| Raven Engineered Films www.ravengeo.com | | | | | | | | | | | | | | | | |
| Hydrflex 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/in ²) | 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) | | | |
| Cooley Group www.cooleygroup.com | | | | | | | | | | | |
| CoolGuard-UCC40 | 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-UCC80 | 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 (EPT) www.epttech.com | | | | | | | | | | | |
| EPT Xtrm Ply fPVC | PVC-GP, NSF 61 and/or ASTM-7176 | width 60" to 120" | 20-120 mils [◊] | 1.3 | 0.5 | 10 [◊] | 50 [◊] | 50 [◊] | 80 [◊] | -30 | CL, SIL, SC, LL, LPL, DL, SR, SC, LC, TL |
| EPT Xtrm Ply fEIA | KEE/EIA-GP, NSF 61 and/or ASTM-7176 | width 60" to 120" | 20-120 mils [◊] | 1.2 | 0.5 | 10 [◊] | 50 [◊] | 50 [◊] | 80 [◊] | -40 | CL, SIL, SC, SR, SC, LC, LPL, TL |
| ◊Data listed is min. value for 20 mil product. | | | | | | | | | | | |
| Layfield Environmental Containment www.layfieldgroup.com | | | | | | | | | | | |
| Arctic Liner | O/C | 1.83/261 (6/855) | 0.76 (30) | 1.15 | 4 | 0.027 (6) | 9.98 (57) | 8.93 (51) | 420 (61) | -54 | SC, SR |
| Plastatech Engineering Ltd. www.plastatech.com | | | | | | | | | | | |
| Plastatech FG (Fish Grade) | PVC - Fish Grade | 76 in. x 480 yd. | 20-30 mil | 1.20 min. | 3-4 max. | 6.0 min. - 8.0 min. | 48 min. - 73 min. | 48 min. - 73 min. | 68 min. - 100 min. | Pass at 5°F (-15°C) and -9.4°F (-23°C) | CL, SIL, SC, LL, DL, LPL |
| Plastatech IG (Industrial Grade) | PVC - Industrial Grade | 76 in. x 1,025 yd. | 10-30 mil | 1.20 min. | 3-4 max. | 2.5 min. - 8.0 min. | 24 min. - 73 min. | 24 min. - 73 min. | 42 min. - 100 min. | Pass at -9.4°F (-23°C), -14.8°F (-26°C) and -20°F (-29°C) | CL, SIL, SC, LL, DL, LPL |
| Plastatech OR (Oil Resistant) | PVC - Oil Resistant | 76 in. x 300 yd. | 30 mil | 1.20 min. | 3 max. | 8.0 min. | 73 min. | 73 min. | 100 min. | Pass at 10.4°F (-12°C) | CL, SIL, SC, LL, DL, LPL |
| SealEco www.sealeco.com | | | | | | | | | | | |
| Elastoseal EPDM | EPDM/TPE | 1.77/100 (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 PGI | PVC | 2.16/224-303.6 (7.08/735-996) | 0.75-1.00 (30-40) | 1.2 | 3 | 0.035-0.044 (8-10) | 12.8-17.0 (73-97) | 12.8-17.0 (73-97) | 690-830 (100-120) | -20 (-4°F) | CL, SIL, SC, 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, SC, 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°F) | CL, SIL, SC, 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 | | | | | | | | | | | | | | | |
| ATARPOL RSP | PP | PP/PES | width: 2.00 (6.5) Length: 20-25 (65.6-82) | 1.0/1.14/ 1.2/ 1.5 mm (40/ 44/ 47/ 60 mil) | ≥ 0.88 | ASTMD 6636 ≥65N | ≤0.3 | NA | NA | NA | NA | -40 | NA | NA | CL, SIL, SIC, DP, RP, roofing |
| ATARTEC RSP Roofing | TPO/ FPO | PP/PES | width: 2.00 (6.5) Length: 15-25 (49-82) | 1.2/ 1.5/ 2.0 mm (47/ 60/ 80 mil) | NP | NP | ≤0.3 | NA | NA | NA | NA | -40 | NA | NA | roofing |
| BTL Liners www.btl liners.com | | | | | | | | | | | | | | | |
| BTL™-10 Woven Clear | LDPE | HDPE | 160,000 f ² | (10 mil) | | | | | MD (62) CD (67) | MD (207) CD (157) | | | | | Greenhouse/ Ag/Rain Covers |
| BTL™-12 Woven Clear | LDPE | HDPE | 155,000 f ² | (12 mil) | | | | 75 LB | MD (65) CD (65) | MD (220) CD (175) | | -40 | | | Greenhouse/ Ag/Rain Covers |
| BTL™-12 Black/ White | LDPE | HDPE | 175,000 f ² | (12 mil) | | | MD -3.6% CD -2.4% | 76 LB | MD(50) CD (50) | MD (140) CD (100) | 130 LB | -40 | MD (110) CD (80) | 5 LB | Greenhouse/ Ag/Rain Covers |
| BTL™-24 | LDPE | HDPE | 75,000 f ² | (24 mil) | | | MD -4.2% CD -3.7% | 182 LB | MD (110) CD (110) | MD (350) CD (335) | 425 LB | -65 | MD (196) CD (35.5) | 5 LB | CL, DP, ILC, LC, LPL, GC, RP, RSC, SIL, SIC, TL |
| BTL™-30 | LDPE | HDPE | 65,000 f ² | (30 mil) | | | MD -2.8% CD -1.5% | 202 LB | MD (50) CD (55) | MD (345) CD (420) | 610 LB | -65 | MD (188) CD (240) | 5 LB | CL, DP, ILC, LC, LPL, GC, RP, RSC, SIL, SIC, TL |
| RPEL-30 | LDPE | HDPE | 55,000 f ² | (30 mil) | | | 0.5% x 0.9% | 325 LB | MD (60) CD (60) | MD (385) CD (385) | 600 LB | -65 | CD 315 lb/in | 24 lb/in | CL, DP, ILC, LC, LPL, GC, RP, RSC, SIL, SIC, TL |
| BTL™-40 | LDPE | HDPE | 50,000 f ² | (40 mil) | | | MD -3.8% CD -1.8% | 347 LB | MD (150) CD (155) | MD (460) CD (450) | 685 LB | -65 | MD (368) CD (360) | 5 LB | CL, DP, ILC, LC, LPL, GC, RP, RSC, SIL, SIC, TL |
| PPL™-45 | LDPE | HDPE | 42,000 f ² | (45 mil) | | | MD -2.1% CD -3.1% | 380 LB | MD (90) CD (90) | MD (385) CD (360) | 880 LB | -65 | MD (308) CD (288) | 5 LB | CL, DP, ILC, LC, LPL, GC, RP, RSC, SIL, SIC, TL |
| Burke Industries www.burkeind.com | | | | | | | | | | | | | | | |
| M283 | CSPE | PET | NP | 36 | 1.45 | -8 | NA | (240)* | (100)** | -275 | (405)[3] | -45 F[5] | NA | NA | NP |
| M284 | CSPE | PET | NP | 45 | 1.45 | -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 | 2.6 (15) | 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 |

[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
 GC = Geofam Cover
 PT = Pillow Tanks

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 | | | | | | | | | | | | | | | |
| CoolGuard HRL36 (PW version available) | 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, SC, SR, SC, LC, TL |
| CoolGuard MPK36 (PW version available) | 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 (PW version available) | EIA | PET | width up to 150 in (3.8 m) | 1.52 (60) | NP | 1.8 (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 |
| 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 |
| 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 |
| 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 L3390NESU | urethane | PET | width = 60 to 68 in (1.5 to 1.7 m) | 1.3 (50) | NP | 2.6 (15) | 2 | NP | 0.18 (40) | 4.9 x 4.9 (1,100 x 1,100) | 4138 (600) | -46 | 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 |
| CoolShield 45E | PVDF | PET | width = 60 to 68 in (1.5 to 1.7 m) | 1.10 (45) | NP | 4.4 (25) | 2 | NP | 0.45 (100) | 1.3 x 1.1 (300 x 250) | 2413 (350) | -29 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| Oasis | TPA | PET | width = 150 in (3.8 m) | 1.52 (60) | NP | 3.5 (20) | 2 | NP | 0.58 (130) | 1.8 x 1.7 (400 x 380) | 4482 (650) | -26 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| Oasis | TPA | PET | width = 196 in (5.0 m) | 1.10 (45) | NP | 2.6 (15) | 2.5 | NP | 0.24 (55) | 1.0 x 1.1 (225 x 2400) | 2413 (350) | -26 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| Engineered Polymer Technologies (EPT) www.epttech.com | | | | | | | | | | | | | | | |
| EPT XTRM Ply TPU | TPU-ester or ether | PET ^o or nylon | 60° - 120° | 30° to 120 | 1.1 ^o -1.2 | 15° | 2 | 400° | 125° | 550° | 800° | -40 | NP | NP | SIL, SIC, SR, SC, LC, TL |
| EPT Xtrm Ply PVC | PVC-GP, NSF 61 or ASTM 7176 ^o | PET | 60° - 120° | 20° to 120 | 1.3 | 15° | 0.5 | 350° | 125° | 550° | 700° | -30 | NP | NP | CL, SIL, SIC, LL, LPL, DL, SR, SC, LC, TL |
| EPT Xtrm Ply KEE/EIA | KEE/EIA-GP, NSF 61 or ASTM 7176 ^o | PET | 60° - 120° | 20° to 120 | 1.2 | 12° | 0.5 | 350° | 125° | 550° | 700° | -35 | NP | NP | CL, SIL, SIC, SR, SC, LC, LPL, TL |
| EPT Xtrm Ply KEE/EIA HPL | KEE/EIA-GP, NSF 61 or ASTM 7176 ^o | PET | 60° - 120° | 30° to 120 | 1.2 | 12° | 0.5* | 400° | 150° | 600° | 900° | -35 | NP | NP | CL, SIL, SIC, SR, SC, LC, LPL, TL |
| EPT Xtrm Ply KEE/EIA Geocomposite | KEE/EIA-2-ply composite (film & nonwoven back), NSF 61 or ASTM 7176 ^o | PET | 60° - 120° | 30° to 120 | 1.2 | 15° | 2 | 75 | 25 | 75 | 200 | -15 | NP | NP | CL, SIL, SIC, SR, SC, LC, LPL, TL |

◊Data listed is min. value for 30 mil products

- [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
GC = Geofam Cover
PT = Pillow Tanks

- 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) | |
| Aquamaster NovaLiner 12 | LDPE | HDPE | 3.65 m x 1800 m (12 ft x 6000 ft) 6600 m ² (72000 ft ²) | 0.30 (12) | NA | NA | -3.6% MD -2.4% CD | 0.34 (76)◇ | 0.22 (50) MD 0.22 (50) CD | 24.5 (140) MD 17.5 (100) CD | 900 (130) | -40C◇◇ | 19.9 (112) MD 14.0 (80) CD | 0.8 (5) | CL, DP, RSC, ILC, SIC |
| Aquamaster NovaLiner 20 | LDPE | HDPE | 3.65 m x 900 m (12 ft x 3000 ft) 3300 m ² (36000 ft ²) | 0.51 (20) | NA | NA | -4.3% MD -1.8% CD | 0.62 (140)◇ | 0.33 (75) MD 0.33 (75) CD | 30.6 (175) MD 47.3 (270) CD | 957 (139) | -65C◇◇ | 24.5 (140) MD 37.8 (216) CD | 0.8 (5) | CL, DP, RSC, ILC, SIC |
| Aquamaster NovaLiner 24 | LDPE | HDPE | 3.65 m x 900 m (12 ft x 3000 ft) 3300 m ² (36000 ft ²) | 0.61 (24) | NA | NA | -3.6% MD -1.0% CD | 0.67 (150)◇ | 0.40 (90) MD 0.41 (92) CD | 42.0 (240) MD 47.3 (270) CD | 1803 (262) | -65C◇◇ | 30.8 (176) MD 25.9 (148) CD | 0.8 (5) | CL, DP, RSC, ILC, SIC, RP |
| Aquamaster NovaLiner 30 | LDPE | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1650 m ² (18000 ft ²) | 0.76 (30) | NA | NA | -4.4% MD -1.8% CD | 0.73 (165)◇ | 0.23 (51) MD 0.33 (74) CD | 32.9 (188) MD 39.4 (225) CD | 2917 (423) | -65C◇◇ | 26.3 (150) MD 31.5 (180) CD | 0.8 (5) | CL, DP, SIL, SIC, LC, RP |
| Aquamaster ArmorLiner 24 | LDPE | HDPE | 3.65 m x 900 m (12 ft x 3000 ft) 3300 m ² (36000 ft ²) | 0.61 (24) | NA | NA | -4.7% MD -1.6% CD | 0.81 (182)◇ | 0.49 (110) MD 0.49 (110) CD | 42.9 (245) MD 43.8 (250) CD | 2927 (425) | -65C◇◇ | 34.8 (196) MD 35.0 (200) CD | 0.8 (5) | CL, DP, SIL, SIC, LC, RP |
| Aquamaster ArmorLiner 30 | LDPE | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1650 m ² (18000 ft ²) | 0.76 (30) | NA | NA | -4.4% MD -1.8% CD | 0.89 (200)◇ | 0.20 (45) MD 0.24 (55) CD | 36.8 (210) MD 56.0 (320) CD | 4206 (610) | -65C◇◇ | 29.4 (168) MD 34.2 (195) CD | 0.8 (5) | CL, DP, SIL, SIC, LC, RP |
| Aquamaster ArmorLiner 40 | LDPE | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1642 m ² (18000 ft ²) | 1.02 (40) | NA | NA | -3.8% MD -1.8% CD | 1.55 (350)◇ | 0.62 (140) MD 0.60 (135) CD | 80.6 (460) MD 80.6 (460) CD | 4723 (685) | -65C◇◇ | 64.5 (368) MD 64.5 (368) CD | 0.8 (5) | CL, DP, SIL, SIC, LC, TL, LPL |
| Aquamaster ArmorLiner 45 | LDPE | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1642 m ² (18000 ft ²) | 1.14 (45) | NA | NA | -2.1% MD -3.1% CD | 1.62 (365)◇ | 0.47 (105) MD 0.49 (110) CD | 76.2 (435) MD 98.9 (565) CD | 6063 (880) | -65C◇◇ | 61.0 (348) MD 51.1 (452) CD | 0.8 (5) | CL, DP, SIL, SIC, LC, TL, LPL |
| Aquamaster ArmorLiner 30SFL | LDPE / LLDPE | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1642 m ² (18000 ft ²) | 0.76 (30) | NA | NA | -2.9% MD -1% CD | 0.87 (195)◇ | 0.35 (79) MD 0.36 (81) CD | 45.5 (260) MD 45.5 (260) CD | 4375 (635) | -65C◇◇ | 36.4 (208) MD 36.4 (208) CD | 0.8 (5) | CL, DP, SIL, SIC, LC, TL, LPL |
| Aquamaster ArmorPad 3NWL | LDPE + PP Non-Woven | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1642 m ² (18000 ft ²) | 0.61 (24)◇◇◇ | NA | NA | -3.6% MD -2.5% CD | 0.60 (135)◇ | 0.44 (100) MD 0.44 (100) CD | 35.0 (200) MD 32.4 (185) CD | 2756 (400) | NA | 35.0 (200) MD 28.0 (160) CD | 0.8 (5) | CL, DP, RP |
| Aquamaster ArmorPad 3NWLD | LDPE + PP Non-Woven | HDPE | 3.65 m x 450 m (12 ft x 1500 ft) 1642 m ² (18000 ft ²) | 0.61 (24)◇◇◇ | NA | NA | -3.6% MD -2.5% CD | 0.60 (135)◇ | 0.44 (100) MD 0.44 (100) CD | 43.8 (250) MD 35.0 (200) CD | 2756 (400) | NA | 35.0 (200) MD 28.0 (160) CD | 0.8 (5) | CL, DP, RP |

◇ ASTM D4833 ◇◇ ASTM D2136 ◇◇◇ Without non-woven layers

[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
 GC = Geofam Cover
 PT = Pillow Tanks

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) | |

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

| | | | | | | | | | | | | | | | |
|-----------------|-----|------|--|-----------|-----|----------|-----|------------|-----------|-------------------|------------|-----|------------|----------------|----|
| HAZGARD 1000 | O/C | PET | 2,300 m ² (25,000 ft ²) | 0.68 (27) | NA | 2.6 (15) | 2 | 1.25 (280) | 0.40 (90) | 1.55 kN (350 lb) | 3100 (450) | -40 | 26.3 (150) | 2.6 (15) | SC |
| HAZGARD 5000 HT | O/C | PET | 1,250 m ² (13,000 ft ²) | 0.76 (30) | N/A | 2.6 (15) | 0.5 | N/A | N/A | 2.67 kN (600 lbs) | 4140 (800) | -35 | 36.8 (210) | 3.5 (20) | SC |
| CSPE 36 | O/C | CSPE | 2,300 m ² (25,000 ft ²) | 0.91 (36) | N/A | 1.22 (7) | 2 | 0.89 (200) | 0.31 (70) | 1.0 (225) | 1.33 (300) | -40 | 0.89 (200) | Film Tear Bond | SC |
| CSPE 45 | O/C | CSPE | 2,135 m ² (23,000 ft ²) | 1.14 (45) | N/A | 1.22 (7) | 2 | 1.0 (225) | 0.36 (80) | 1.11 (250) | 1.56 (350) | -40 | 1.0 (225) | Film Tear Bond | SC |
| CSPE 60 | O/C | CSPE | 1670 m ² (18,000 ft ²) | 1.52 (60) | N/A | 1.22 (7) | 2 | 1.33 (300) | 0.36 (80) | 1.33 (300) | 1.78 (400) | -40 | 1.2 (270) | Film Tear Bond | SC |

Owens Corning | www.owenscorning.com/rhinomat

| | | | | | | | | | | | | | | | |
|---------------|-------|------|---------------------------------|--------|-------|-----------------|-------------|--------|---------------|---------------|---------|------|--------------|-----------|---|
| RhinoSkin 12 | LDPE | HDPE | up to 100,000 sq. ft./144" wide | 12 mil | 0.971 | NA [◇] | 0.5% x 0.3% | 156 lb | 60lb x 55 lb | 175lb x 210lb | 340 psi | -60C | CD 172 lb/in | 3.0 lb/in | agriculture crop covers, rain covers, etc. |
| RhinoSkin 16 | LDPE | HDPE | up to 100,000 sq. ft./144" wide | 16 mil | 0.970 | NA [◇] | 0.5% x 0.2% | 210 lb | 75lb x 70 lb | 230lb x 210lb | 400 psi | -60C | CD 172 lb/in | 4.0 lb/in | agriculture crop covers, rain covers, etc. |
| RhinoSkin 20 | LDPE | HDPE | up to 100,000 sq. ft./144" wide | 20 mil | 0.970 | NA [◇] | 0.3% x 0.3% | 270 lb | 100lb x 90 lb | 330lb x 286lb | 600 psi | -60C | CD 235 lb/in | 5.0 lb/in | oil and gas, canal liners, secondary containment. |
| RhinoSkin 24 | LDPE | HDPE | up to 100,000 sq. ft./144" wide | 24 mil | 0.972 | NA [◇] | 0.4% x 0.2% | 275 lb | 95lb x 85 lb | 350lb x 300lb | 680 psi | -60C | CD 246 lb/in | 5.5 lb/in | oil and gas, canal liners, secondary containment. |
| RhinoSkin 30 | LDPE | HDPE | up to 100,000 sq. ft./144" wide | 30 mil | 0.970 | NA [◇] | 0.4% x 0.2% | 305 lb | 95lb x 85 lb | 375lb x 315lb | 720 psi | -60C | CD 258 lb/in | 6.5 lb/in | oil and gas, canal liners, secondary containment. |
| RhinoMat 300 | LLDPE | HDPE | up to 100,000 sq. ft./144" wide | 15 mil | 0.967 | NA [◇] | 0.5% x 0.9% | 164 lb | 50lb x 50 lb | 180lb x 215lb | 345 psi | -60C | CD 176 lb/in | 15 lb/in | water containment—shallow impoundments. |
| RhinoMat 500 | LLDPE | HDPE | up to 100,000 sq. ft./144" wide | 24 mil | 0.970 | NA [◇] | 0.5% x 0.9% | 280 lb | 55lb x 55 lb | 330lb x 300lb | 600 psi | -60C | CD 246 lb/in | 20 lb/in | water containment—moderate impoundments. |
| RhinoMat 750 | LLDPE | HDPE | up to 100,000 sq. ft./144" wide | 30 mil | 0.970 | NA [◇] | 0.6% x 0.2% | 305 lb | 60lb x 60 lb | 385lb x 385lb | 700 psi | -60C | CD 315 lb/in | 24 lb/in | water containment—moderate impoundments. |
| RhinoMat 1000 | LLDPE | HDPE | up to 100,000 sq. ft./144" wide | 40 mil | 0.970 | NA [◇] | 0.6% x 0.3% | 340 lb | 70lb x 70 lb | 418lb x 385lb | 800 psi | -60C | CD 315 lb/in | 24 lb/in | water containment—deep impoundments. |

◇ Membrane could not be pulled off in one piece in order to conduct the test

Plastatech Engineering Ltd. | www.plastatech.com

| | | | | | | | | | | | | | | | |
|-------------------|-----|-----|------------------|--------|-----|-----|------------------|------|---------------|-----|------|-----|-----|-----|----------------------|
| Plastatech Tech 5 | PVC | PVC | 64 in. x 150 yd. | 30 mil | n/a | n/a | -0.7 MD/0.03 CMD | >180 | 105 MD/81 CMD | n/a | >660 | n/a | n/a | n/a | CL, DP, RP, RSC, SIL |
|-------------------|-----|-----|------------------|--------|-----|-----|------------------|------|---------------|-----|------|-----|-----|-----|----------------------|

- [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
GC = Geofam Cover
PT = Pillow Tanks

- 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) | |
| Dura-Skrim N30B - Meets GRI-GM25 | LLDPE | PET | 3700 m ² (40,000 ft ²) | 0.69 (27) | NP | 3 (17) | <1% | .36 (80)♦ | 0.33 (70) | 38 (220)♦♦ | NP | <-40 | 9.6 (55) | 7 (40) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim N36B - Meets GRI-GM25 | LLDPE | PET | 2800 m ² (30,000 ft ²) | 0.81 (32) | NP | 3.6 (21) | <1% | .38 (85)♦ | 0.36 (80) | 42 (240)♦♦ | NP | <-40 | 13 (75) | 8 (45) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim N45B - Meets GRI-GM25 | LLDPE | PET | 2400 m ² (26,000 ft ²) | 1.01 (40) | NP | 4.2 (24) | <1% | .40 (90)♦ | 0.45 (100) | 48 (275)♦♦ | NP | <-40 | 17 (95) | 8.7 (50) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim R248V - Meets GRI-GM22 | LLDPE | PET | 4600 m ² (50,000 ft ²) | 0.43 (17.0) | NP | NA | NP | NP | 0.29 (60) | 0.34 (77)♦♦ | 1034 (150)♦♦♦ | <-40 | NP | NP | ILC, SIL, SIC, RP |
| Dura-Skrim R208DV - Meets GRI-GM22 | LLDPE | PET | 5300 m ² (57,000 ft ²) | 0.33 (13.0) | NP | NA | NP | NP | 0.25 (55) | 0.27 (60) | 772 (112)♦♦♦ | <-40 | NP | NP | ILC, SIL, SIC, RP |
| Dura-Skrim R128V - Meets GRI-GM22 | LLDPE | PET | 7600 m ² (82,000 ft ²) | 0.28 (11.0) | NP | NA | NP | NP | 0.13 (30) | 10.5 (60)♦♦ | 621 (90)♦♦♦ | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim R12WB | LLDPE | PET | 7600 m ² (82,000 ft ²) | 0.28 (11.0) | NP | NA | NP | NP | 0.13 (30) | 10.5 (60)♦♦ | 621 (90)♦♦♦ | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim R88V - Meets GRI-GM22 | LLDPE | PET | 11000 m ² (120,000 ft ²) | 0.18 (7.2) | NP | NA | NP | NP | 0.09 (20) | 9.6 (55)♦♦ | 485 (70)♦♦♦ | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim R8WB | LLDPE | PET | 11000 m ² (120,000 ft ²) | 0.18 (7.2) | NP | NA | NP | NP | 0.09 (20) | 9.6 (55)♦♦ | 485 (70)♦♦♦ | <-40 | NP | NP | ILC, RSC, RP |
| Dura-Skrim NQ36B - Meets GRI-GM18 | Flexible PP | PET | 2800 m ² (30,000 ft ²) | 0.81 (32) | NP | 3.5 (20) | <1% | .36 (80)♦ | 0.40 (90) | 35 (200)♦♦ | NP | <-40 | 13 (75) | 7.0 (40) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim NQ45B - Meets GRI-GM18 | Flexible PP | PET | 2400 m ² (26,000 ft ²) | 1.02 (40) | NP | 3.8 (22) | <1% | .38 (85)♦ | 0.49 (110) | 44 (250)♦♦ | NP | <-40 | 18 (100) | 8.7 (50) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim N36BT1 - Meets GRI-GM25 | LLDPE Textured 1-Side | PET | 1200 m ² (13,000 ft ²) | 0.79 (31) | NP | 5.4 (31) | <1% | .38 (85)♦ | 0.36 (80) | 42 (240)♦♦ | NP | <-40 | 13 (75) | 8 (45) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim N36BT2 - Meets GRI-GM25 | LLDPE Textured 2-Side | PET | 1200 m ² (13,000 ft ²) | 0.79 (31) | NP | 5.4 (31) | <1% | .38 (85)♦ | 0.36 (80) | 42 (240)♦♦ | NP | <-40 | 13 (75) | 8 (45) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim N45BT1 - Meets GRI-GM25 | LLDPE Textured 1-Side | PET | 1200 m ² (13,000 ft ²) | 0.99 (39) | NP | 5.6 (32) | <1% | .40 (90)♦ | 0.45 (100) | 48 (275)♦♦ | NP | <-40 | 17 (95) | 8.7 (50) | CL, SIL, SIC, LPL, TL, LC, DP |
| Dura-Skrim N45BT2 - Meets GRI-GM25 | LLDPE Textured 2-Side | PET | 1200 m ² (13,000 ft ²) | 0.99 (39) | NP | 5.6 (32) | <1% | .40 (90)♦ | 0.45 (100) | 48 (275)♦♦ | NP | <-40 | 17 (95) | 8.7 (50) | CL, SIL, SIC, LPL, TL, LC, DP |

♦ Puncture Resistance ASTM D4833

♦♦ Tensile Strength ASTM D7003

♦♦♦ Mullen Burst ASTM D751

- [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
 GC = Geofabric Cover
 PT = Pillow Tanks

- 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) | |
| Seaman Corporation www.xr-technology.com | | | | | | | | | | | | | | | |
| 6730 XR-5 | EIA | PET | 1,400 m ² 15,000 ft ² | 0.75 (30) | 1.2 app. | 2.63 (15) | 0.5 | 400 | 70 | 2.46 (550) | 5520 (800) | -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 (800) | -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 (800) | -35 | 2.46 (550) | 3.50 (20) | CL, SIL, SIC, LL, DL, LC, LPL |
| 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 (800) | -35 | 2.46 (550) | 3.50 (20) | CL, SIL, SIC, LL, DL, LC, LPL |
| 8228 XR-3 | EIA | PET | 1,400 m ² 15,000 ft ² | 0.75 (30) | 1.2 app. | 2.10 (12) | 0.5 | 205 | 50 | 0.89 (200) | 2070 (300) | -32 | 1.11 (250) | 1.75 (10) | CL, SIL, SIC, LC, LPL |
| 8142 XR-5 PW | EIA | PET | 1,200 m ² 13,000 ft ² | 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 |
| 9832 XR-5G | EIA | PET | 1,400 m ² 15,000 ft ² | 0.914 (36) | 1.2 app. | 2.63 (15) | 0.5 | 440 | 125 | 2.90 (650) | 5520 (800) | -40 | 2.90 (650) | 3.50 (20) | CL, SIL, SIC, LL, DL, LC, LPL, GC |
| 8123 ULTA | TPU | PET | 1,400 m ² 15,000 ft ² | 0.635 (25) | 1.2 app. | 1.75(10) | 0.5 | 350 | 125 | 2.23 (500) | 3450 (500) | -65 | 2.23 (500) | 3.50 (20) | CL, SIL, SIC, LL, LC |
| 1936 PTF | TPU | nylon | 1,400 m ² 15,000 ft ² | 1.0 (40) | 1.2 app. | 7.01(40) | 0.5 | 700 | 125 | 4.46 (1,000) | 10,340 (1,500) | -50 | 4.46 (1000) | 3.50 (20) | SIL, OB, PT |

[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
 GC = Geofom Cover
 PT = Pillow Tanks

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