

APPENDIX H
Liner Product Information

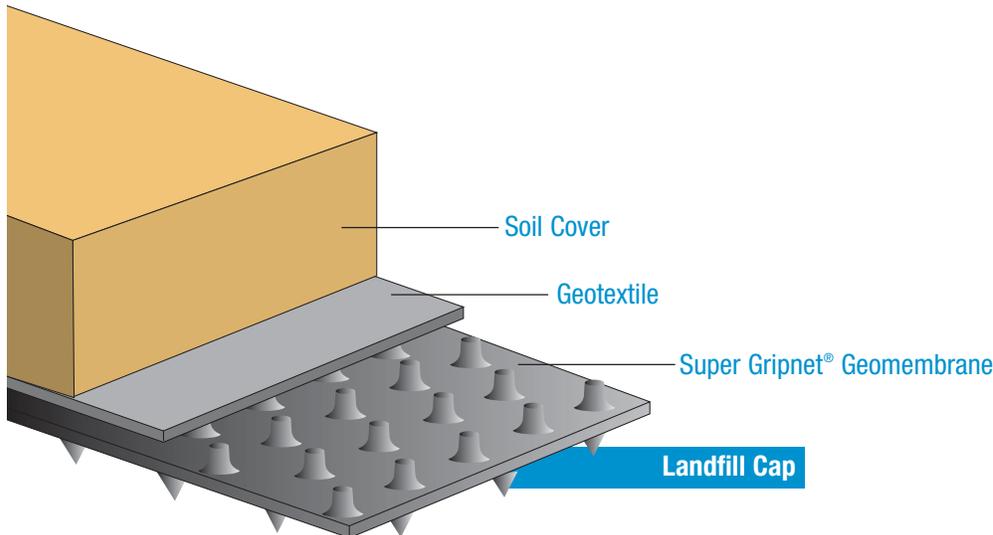
2010 Report of Waste Discharge, Bishop Mill Project

Super Gripnet® Geomembrane



Applications for HDPE and LLDPE Agru Super Gripnet® include projects where drainage and high interface friction as well as cost savings are critical i.e. landfill caps, landfill slopes and mining reclamation projects. Recent bids for installations have indicated cost savings of over \$3,000.00 per acre with the use of Super Gripnet® as a replacement for traditional geocomposite overlying a textured geomembrane.

Agru America's structured geomembranes are manufactured on state-of-the-art manufacturing equipment using a flat cast extrusion manufacturing process as opposed to blown film extrusion. Agru America uses only the highest grade of HDPE and LLDPE resins manufactured in North America. The structured geomembrane is manufactured by a continuous horizontal flat die extrusion into profile rollers. The machined rollers give the product the final structured surface with drainage studs and spikes which are an integral (homogenous) part of the liner and have a smooth edge for on site welding. This process provides a consistent core thickness resulting in higher sheet tensile strength, consistent high profile texturing resulting in higher interface friction capabilities as well as consistent drain capacity.



Interface Shear – Cap Loading Conditions ASTM D 5321

Soil/Grip Liner Surface	P	LD
Coarse Sand	35°	31°
Glacial Till	38°	34°
Silty Sand	28°	26°
Non Woven GT	31°	26°

Soil/Drain Liner Surface with GT		
Coarse Sand	30°	30°

Note: The above values are representative friction angles only. It is recommended that site specific conformance testing be carried out using the actual soils, geosynthetics and loading conditions for a specific project.

P = Maximum or Peak Interface Shear Value in degrees
 LD = Large Displacement Interface Shear Value in degrees
 GT = Geotextile

- Combines Drainage with Shear Resistance
- High Water Flow Rate on Top Side
- Spike/ Texture Bottom
- Consistent Drain and Structure Pattern
- Combine with Smooth
- Combine with Fabric

Super Gripnet® Geomembrane



US Patent - No. 5.258.217

The machine rollers provide the final structured surface with a 3.6 mm (0.145 in.) high studded drain surface on the top side and 4.4 mm (0.175 in.) high spiked friction surface on the bottom side. The 7 m (23 ft.) wide rolls of finished product include a smooth edge on both sides of the roll for ease of thermal welding in the field. Due to the molded structure, core thickness does not vary as with blown film textured sheet, thus mechanical properties of the sheet are not affected. In addition, the consistent high profile texture insures optimum interface friction characteristics at any point on the sheet surface.

The top surface integral drain structure consists of 3.2 mm (0.13 in.) diameter studs 3.6 mm (0.145 in.) in height and spaced on a diamond pattern of 12.5 mm (0.5 in.) spacing. A filter/protection geotextile is required to be placed on the drain profile. The geotextile is heat set on one side (placed against the drain structure) to reduce intrusion into the drain. Large-scale flow rate testing with this configuration, overlying soils and expected normal loads resulted in high planar flow rates.

The bottom spiked friction surface with 4.4 mm (0.175 in.) high spikes and patterned texture provides maximum interface friction and high factor of safety against sliding.

Thus, the Super Gripnet® Liner is a synthetic drainage media which has decided advantages over conventional geocomposites:

- **Cost Savings** – The drain media and liner are one and installed as one panel
 - No waste due to fitting of geocomposite sections or discarding roll ends
- **Improved Planar Flow** – Less reduction for chemical/biological clogging considerations
- **Consistent Material** – Studs and spikes (drainage and friction) totally integrated with the geomembrane
- **High Interface Shear** – Exceptional shear resistance between soil & geotextile components allows flexibility and stability during protective cover material placement
- **Meets/exceeds Project Requirements** – Excellent fluid barrier
 - Excellent drainage medium
 - Excellent friction characteristics

Agru's Super Gripnet® geomembrane is a high performance liner system with integrated top surface drainage supplying the functional needs for any project with the added benefit of substantial cost savings.

Why specify or use anything else!

Agru has over 20 years experience with Geomembranes and 50 years experience with Thermoplastic Extrusion Agru offers a wide range of concrete protective liners (Sure Grip), pipe fittings and semi-finished materials.

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High Density Polyethylene Super Gripnet® Liner



Product Data

Property	Test Method	Values			
Thickness (min. ave.), mil (mm)	ASTM D5994*	50 (1.25)	60 (1.5)	80 (2.0)	100 (2.5)
Thickness (lowest indiv.), mil (mm)	ASTM D5994*	50 (1.25)	54 (1.35)	72 (1.8)	90 (2.25)
*The thickness values may be changed due to project specifications (i.e., absolute minimum thickness)					
Drainage Stud Height (min. ave.), mil (mm)	GRI GM12	145 (3.68)	145 (3.68)	145 (3.68)	145 (3.68)
Friction Spike Height (min. ave.), mil (mm)	GRI GM12	175 (4.45)	175 (4.45)	175 (4.45)	175 (4.45)
Density, g/cc, minimum	ASTM D792, Method B	0.94	0.94	0.94	0.94
Tensile Properties (ave. both directions)	ASTM D6693, Type IV				
Strength @ Yield (min. ave.), lb/in width (N/mm)	2 in/minute	95 (16.6)	114 (20.0)	152 (26.6)	190 (33.3)
Elongation @ Yield (min. ave.), % (GL=1.3in)	5 specimens in each direction	13	13	13	13
Strength @ Break (min. ave.), lb/in width (N/mm)		105 (18.4)	126 (22.1)	168 (29.4)	210 (36.8)
Elongation @ Break (min. ave.), % (GL=2.0in)		200	200	200	200
Tear Resistance (min. ave.), lbs. (N)	ASTM D1004	38 (169)	40 (178)	53 (236)	64 (285)
Puncture Resistance (min. ave.), lbs. (N)	ASTM D4833	80 (356)	90 (400)	120 (534)	150 (667)
Carbon Black Content (range in %)	ASTM D4218	2 - 3	2 - 3	2 - 3	2 - 3
Carbon Black Dispersion (Category)	ASTM D5596	Only near spherical agglomerates for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3			
Stress Crack Resistance (Single Point NCTL), hours	ASTM D5397, Appendix	300	300	300	300
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O ₂	≥100	≥100	≥100	≥100
Melt Flow Index, g/10 minutes	ASTM D1238, 190°C, 2.16kg	≤1.0	≤1.0	≤1.0	≤1.0
Oven Aging	ASTM D5721	80	80	80	80
with HP OIT, (% retained after 90 days)	ASTM D5885, 150°C, 500psi O ₂				
UV Resistance	GRI GM11	20hr. Cycle @ 75°C/4 hr. dark condensation @ 60°C			
with HP OIT, (% retained after 1600 hours)	ASTM D5885, 150°C, 500psi O ₂	50	50	50	50

These product specifications meet or exceed GRI's GM13

Supply Information (Standard Roll Dimensions)

Thickness		Width		Length		Area (approx.)		Weight (average)	
mil	mm	ft	m	ft	m	ft ²	m ²	lbs	kg
50	1.25	23	7	280.2	85.4	6,435	598	2,750	1,248
60	1.5	23	7	280.2	85.4	6,435	598	2,800	1,270
80	2.0	23	7	280.2	85.4	6,435	598	3,550	1,610
100	2.5	23	7	164	50	3,768	350	2,418	1,096

Notes:

All rolls are supplied with two slings. All rolls are wound on a 6 inch core. Special roll lengths are available on request.

All information, recommendations and suggestions appearing in this literature concerning the use of our products are based upon tests and data believed to be reliable; however, it is the users responsibility to determine the suitability for their own use of the products described herein. Since the actual use by others is beyond our control, no guarantee or warranty of any kind, expressed or implied, is made by Agru/America as to the effects of such use or the results to be obtained, nor does Agru/America assume any liability in connection herewith. Any statement made herein may not be absolutely complete since additional information may be necessary or desirable when particular or exceptional conditions or circumstances exist or because of applicable laws or government regulations. Nothing herein is to be construed as permission or as a recommendation to infringe any patent.

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High Density Polyethylene Smooth Liner™



Product Data

Property	Test Method	Values				
Thickness (min. ave.), mil (mm)	ASTM D5199*	30 (.75)	40 (1.0)	60 (1.5)	80 (2.0)	100 (2.5)
Thickness (lowest indiv.), mil (mm)	ASTM D5199*	27 (.68)	36 (.90)	54 (1.35)	72 (1.80)	90 (2.25)
* The thickness values may be changed due to project specifications (i.e., absolute minimum thickness)						
Density, g/cc, minimum	ASTM D792, Method B	0.94	0.94	0.94	0.94	0.94
Tensile Properties (ave. both directions)	ASTM D6693, Type IV					
Strength @ Yield (min. ave.), lb/in width (N/mm)	2 in/minute	66 (11.6)	88 (15.4)	132 (23.1)	176 (30.8)	220 (38.5)
Elongation @ Yield (min. ave.), % (GL=1.3in)	5 specimens in each direction	13	13	13	13	13
Strength @ Break (min. ave.), lb/in width (N/mm)		120 (21)	160 (28)	240 (42)	320 (56)	400 (70)
Elongation @ Break (min. ave.), % (GL=2.0in)		700	700	700	700	700
Tear Resistance (min. ave.), lbs. (N)	ASTM D1004	23 (102)	30 (133)	45 (200)	60 (267)	72 (320)
Puncture Resistance (min. ave.), lbs. (N)	ASTM D4833	60 (267)	80 (356)	120 (534)	160 (712)	190 (845)
Carbon Black Content (range in %)	ASTM D4218	2 - 3	2 - 3	2 - 3	2 - 3	2 - 3
Carbon Black Dispersion (Category)	ASTM D5596	Only near spherical agglomerates for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3				
Stress Crack Resistance (Single Point NCTL), hours	ASTM D5397, Appendix	300	300	300	300	300
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O ₂	≥100	≥100	≥100	≥100	≥100
Melt Flow Index, g/10 minutes	ASTM D1238, 190°C, 2.16kg	≤1.0	≤1.0	≤1.0	≤1.0	≤1.0
Oven Aging	ASTM D5721	80	80	80	80	80
with HP OIT, (% retained after 90 days)	ASTM D5885, 150°C, 500psi O ₂					
UV Resistance	GRI GM11	20hr. Cycle @ 75°C/4 hr. dark condensation @ 60°C				
with HP OIT, (% retained after 1600 hours)	ASTM D5885, 150°C, 500psi O ₂	50	50	50	50	50

These product specifications meet or exceed GRI's GM13

Supply Information (Standard Roll Dimensions)

Thickness		Width		Length		Area (approx.)		Weight (average)	
mil	mm	ft	m	ft	m	ft ²	m ²	lbs	kg
30	.75	22.5	6.86	839.9	256	18,904	1,756	3,218	1,459
40	1.0	22.5	6.86	649.6	198	14,621	1,358	3,113	1,412
60	1.5	22.5	6.86	419.9	128	9,452	878	3,006	1,363
80	2.0	22.5	6.86	321.5	98	7,237	672	3,067	1,391
100	2.5	22.5	6.86	249.4	76	5,612	521	2,995	1,313

Notes:

All rolls are supplied with two slings. All rolls are wound on a 6 inch core. Special roll lengths are available on request.

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High Density Polyethylene Drain Liner™



Product Data

Property	Test Method	Values			
Thickness (min. ave.), mil (mm)	ASTM D5994*	50 (1.25)	60 (1.5)	80 (2.0)	100 (2.5)
Thickness (lowest indiv.), mil (mm)	ASTM D5994*	50 (1.25)	54 (1.35)	72 (1.8)	90 (2.25)
*The thickness values may be changed due to project specifications (i.e., absolute minimum thickness)					
Drainage Stud Height (min. ave.), mil (mm)	GRI GM12	145 (3.68)	145 (3.68)	145 (3.68)	145 (3.68)
Density, g/cc, minimum	ASTM D792, Method B	0.94	0.94	0.94	0.94
Tensile Properties (ave. both directions)	ASTM D6693, Type IV				
Strength @ Yield (min. ave.), lb/in width (N/mm)	2 in/minute	95 (16.6)	120 (21)	160 (28)	220 (38.5)
Elongation @ Yield (min. ave.), % (GL=1.3in)	5 specimens in each direction	13	13	13	13
Strength @ Break (min. ave.), lb/in width (N/mm)		105 (18.4)	132 (23.1)	176 (30.8)	220 (38.5)
Elongation @ Break (min. ave.), % (GL=2.0in)		200	200	200	200
Tear Resistance (min. ave.), lbs. (N)	ASTM D1004	38 (169)	50 (222)	67 (298)	83 (369)
Puncture Resistance (min. ave.), lbs. (N)	ASTM D4833	80 (355)	95 (422)	126 (560)	158 (703)
Carbon Black Content (range in %)	ASTM D4218	2 - 3	2 - 3	2 - 3	2 - 3
Carbon Black Dispersion (Category)	ASTM D5596	Only near spherical agglomerates for 10 views: 9 views in Cat. 1 or 2, and 1 view in Cat. 3			
Stress Crack Resistance (Single Point NCTL), hours	ASTM D5397, Appendix	300	300	300	300
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O ₂	≥100	≥100	≥100	≥100
Melt Flow Index, g/10 minutes	ASTM D1238, 190°C, 2.16kg	≤1.0	≤1.0	≤1.0	≤1.0
Oven Aging	ASTM D5721				
with HP OIT, (% retained after 90 days)	ASTM D5885, 150°C, 500psi O ₂	80	80	80	80
UV Resistance	GRI GM11	20hr. Cycle @ 75°C/4 hr. dark condensation @ 60°C			
with HP OIT, (% retained after 1600 hours)	ASTM D5885, 150°C, 500psi O ₂	50	50	50	50

These product specifications meet or exceed GRI's GM13

Supply Information (Standard Roll Dimensions)

Thickness		Width		Length		Area (approx.)		Weight (average)	
mil	mm	ft	m	ft	m	ft ²	m ²	lbs	kg
50	1.25	23	7	263	80	6,028	560	2,060	934
60	1.5	23	7	263	80	6,028	560	2,295	1,041
80	2.0	23	7	230	70	5,274	490	2,489	1,129
100	2.5	23	7	197	60	4,521	420	2,489	1,129

Notes:

All rolls are supplied with two slings. All rolls are wound on a 6 inch core. Special roll lengths are available on request.

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